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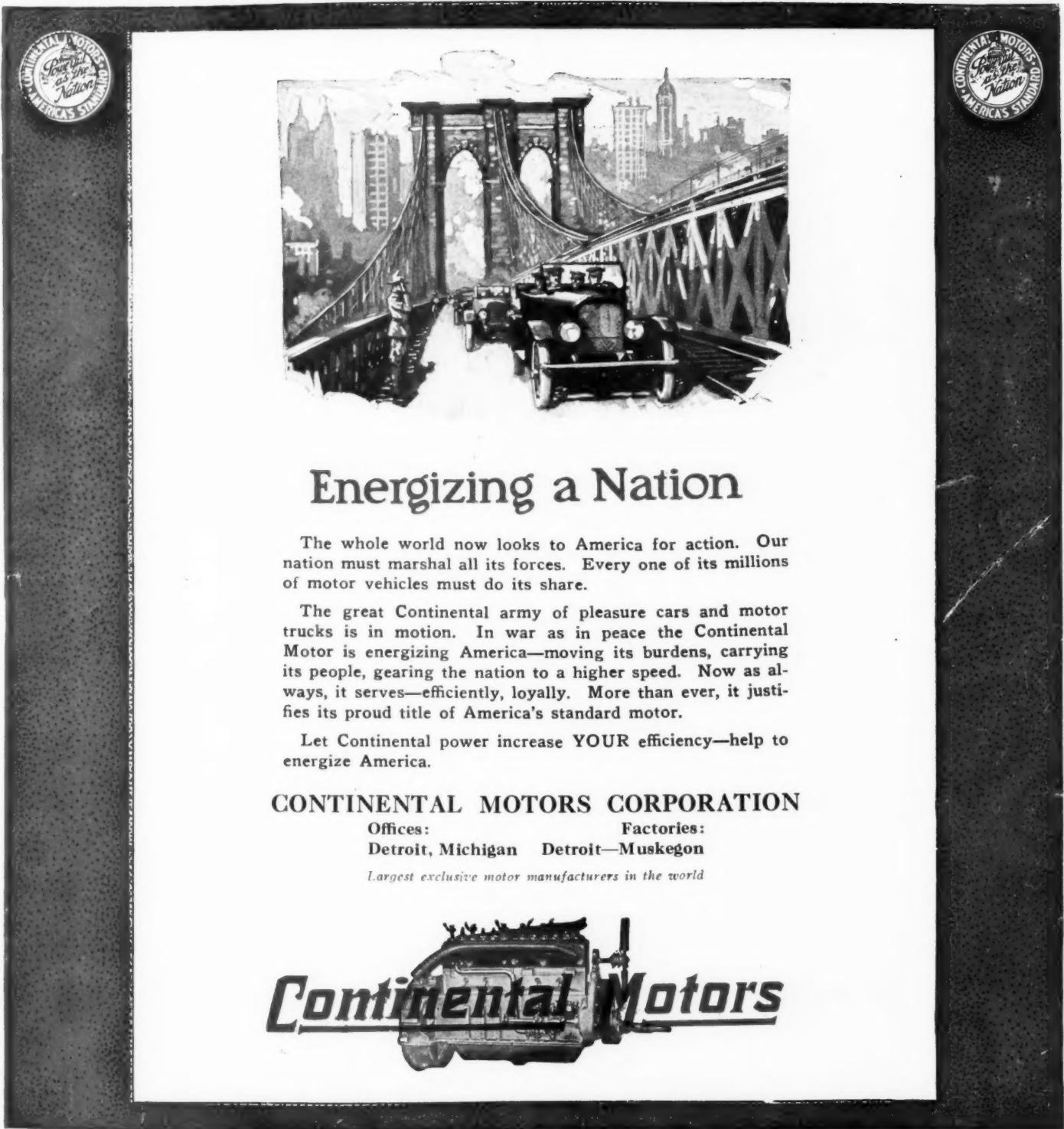
AUTOMOTIVE ISSUE

UNIVERSAL The AUTOMOBILE

Vol. XXXVI
No. 26

NEW YORK, JUNE 28, 1917

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The AUTOMOBILE

VOL. XXXVI

NEW YORK—THURSDAY, JUNE 28, 1917—CHICAGO

No. 26

S. A. E. Is Big Factor in Crisis

**Most Momentous Summer Meeting in History of Society
Marked by Active Government Participation—
Over 700 Members and Guests Present—War Atmos-
phere Lifts Sessions to Highest Plane Ever Attained**

By J. Edward Schipper

WASHINGTON, June 26.—It was impossible to come away from the 2-day session of the Society of Automotive Engineers, which closed here to-night, without the deepest conviction that the S. A. E. is going to prove one of the Government's strongest instrumentalities in fashioning the nation's destiny. From the moment the standards committee meeting opened yesterday, at the Bureau of Standards, until the convention came to a close after the banquet to-night, where Secretary of War Newton D. Baker delivered an inspiring address, every one of the 700 members and guests present was made to feel that he is an important unit in the future plans of the nation.

Every part of the meeting was characterized by excellent attendance and an interested earnestness which put the 1917 summer meeting of the Society of Automotive Engineers on the highest plane in the history of the society. The organization, which has now grown to a total membership of 3030, showed itself to have broadened out into the automotive field with a rapidity that has surpassed all expectations.

The idea of holding the meeting at the nation's capital was shown to be

Accomplishments

STANDARDS ADDED

Aeronautic
Ball and Roller Bearings
Chains
Data Sheet
Electrical Equipment
Engine
Lighting
Miscellaneous
Research
Starting Battery
Tire and Rim
Tractor

PAPERS PRESENTED

Submarine Chaser Construction
Henry R. Sutphen
Tractors and the Food Problem
H. L. Horning
Aircraft in War Time
I. W. Seddon
Uses of Battleplanes
Lieut. Amaury de la Grange

PAPERS TO BE PRINTED

Kerosene-Burning Tractor Engine
Fundamentals
C. E. Sargent
Lessons of War in Truck Design
W. O. Thomas

distinctly proper. There was hardly a report of the standards committee, and not a single paper, that was not strongly touched with the influence of the war problems of the nation. The statement that this is a war of internal combustion engineering was shown to be true from all the angles represented by the society in the automobile, tractor, aeronautical and marine fields.

The meeting opened yesterday, June 25, with the standards committee session at the Bureau of Standards Buildings. The session was the best attended of any standards committee meetings ever held by the society. A notable feature was the attendance of a large number of members of the society who are not members of the standards committee. This resulted in thoroughly imparting to these members the spirit in which the standards committee is carrying out its work. Consequently, on the following day, when the matters which had passed the committee were brought up for action by the general society, no delay was experienced, and the entire conduct of the meeting was accelerated.

The net result of the meeting was the addition of an important series of standards to the list already estab-

lished by the S. A. E., and in addition the papers at the professional session served to impart an important knowledge of war work to the assembled automotive engineers. The divisions which added standards as a result of the summer meeting are the aeronautic, ball and roller bearings, chain, data sheet, electrical equipment, engine, lighting, miscellaneous, research, starting battery, tire and rim, and tractor. Of great importance is the work done in both the aeronautic and the tractor divisions because of the economical effect these will have upon the big building program laid out for the Government air service and in the case of the tractor division because the standards adopted form a foundation which may prove to be the cornerstone of the entire industry, which is at present practically without any standardization.

President Dunham's Powerful Address

President George Dunham opened the meeting with a powerful address reviewing the work of the society and telling of its activities in the present struggle. He pledged the support of the society to the government in its war work, and he told of those who have already entered the service from the society. A point which he made is that it is noteworthy that six past presidents of the society are taking prominent parts in government work. Past-President Riker is a member of the Naval Consulting Board; Past-President Coffin, who did efficient work in connection with the Industrial Preparedness Committee of the Naval Consulting Board, is a member of the Advisory Commission of the Council of National Defense. He is also chairman of the Aircraft Production Board.

Past-President Souther is the senior officer of the Aircraft Engineering Division of the Aviation section of the Signal Corps, with the rank of major. Past-President Marmon is doing engineering work with the Aircraft Engineering Division. Past-President Alden has been made a major in the Ordnance Officers' Reserve Corps; Past-President Vandervoort is acting as a member of the Munitions Sub-committee of the Council of National Defense.

Former Vice-President Zimmerschied is vice-chairman of the Automotive Transport Committee of the Council of National Defense. Former Vice-President William G. Wall is now a major in the Ordnance Officers' Reserve Corps. Vice-President Vincent has been doing work of the greatest importance in connection with aeronautic matters at the Bureau of Standards. The members of the council are spending a considerable part of their time at Washington, and your president is the civilian member of the board for motorizing field artillery at the Bureau of Ordnance.

The professional session held during the afternoon of the second day, when all the standards work had been concluded, had upon its program six papers. Of these four were presented, and each of them was so intimately connected with the probable activities of the S. A. E. in the present struggle that the meeting could be characterized as a war session of the society. Henry R. Sutphen presented a paper dealing with the standardized construction of the high speed motor boats used as submarine chasers. Wing Commander I. W. Seddon of the British Commission, who has had actual war experience with the British flying corps, spoke of the design and production of aircraft in war time and gave his views on the way in which America could aid in establishing the supremacy of the air. Lieutenant Amaury de la Grange, of the French Commission, and also experienced in the flying work of the present war, spoke of the classes and uses of battle planes and also pointed out what America must do in order to maintain a clear sky for the use of the Allies' reconnaissance machines. H. L. Horning presented a study of the farm tractor as related to the food problem not only of this war, but of the coming increasing population of the world.

Membership Report

The two other papers on the professional program were presented by title, and it is probable that written discussions on these will be included in the transactions. These two other papers were Fundamentals of a Successful Kerosene-Burning Tractor Engine by C. E. Sargent and Lessons of the War in Truck Design by W. O. Thomas.

Very little time was spent on the business part of the meeting. The affairs of the society are in excellent condi-

tion, the most important problem ahead of the organization being to increase its membership to 5000. That this goal should be reached with little delay is indicated by the growth during the last 18 months. On June 1, 1916, the membership of the S. A. E. was 1911; on Jan. 1, 1917, it was 2121, an increase of but a little over 200. On June 1, 1917, a 6-month period, it had increased to 2640, and on the date of the meeting, June 26, it had reached 3030. President Dunham urged upon the members in attendance with great earnestness the importance of increasing the membership. He exacted a pledge from every member present that they would get at least one new member and many promised more. The membership of the society at present, as divided into grades, stands as follows: Members 1562, associates 951, juniors 266, student enrollments 130, affiliates 51 and affiliate representatives 70.

The treasurer's report showed that on Oct. 1, 1916, there was a balance on hand of \$22,885.37. The receipts since that time from all sources amounted to \$83,804.39, making a total of \$106,749.76. Expenses amounted to \$78,239.41, leaving a balance on hand of \$28,510.35. Of this sum, \$12,000 was invested in Liberty bonds. The treasurer's report was accepted.

Dr. Stratton, chief of the Bureau of Standards, was introduced to the audience and gave a brief talk. He impressed upon the engineers present that it was the desire of the Bureau of Standards to co-operate with them in the problems of their work to the greatest possible extent. He desired particularly close relationship with the different technical societies. The duty of the Bureau of Standards, he said, consists in bringing together all the people interested in any particular line of work and then help them to solve their problems.

Report of Standards Committee Chairman

J. G. Utz, chairman of the standards committee, made a short address to the members of the society, outlining the work of the committee. He told how the work had broadened out into the entire automotive field and how the work of the standards committee will be of material benefit to the industries in which the work of standardization has not gathered the full headway that it has in the automobile business.

Some diagrams were shown on the screen illustrating Mr. Utz's talk, and while these are no longer up to date due to later action of the committee, it was shown that there are 114 car standards on the books, 77 truck, 67 motor boat, 51 electrical and 14 aeronautical. To this must be added the tractor standards which have now been adopted with the exception of the formality of a mail vote by the members of the society and also the standards in other fields. Mr. Utz predicted that next year there would be in addition a number of standards on the motorcycle and stationary gas engine.

The general meeting of the society was divided into two heads with the standards reports taken up in the forenoon and the afternoon devoted to the professional papers. The action of the general body on the various standards reports followed quite closely that which was indicated by the standards committee on the day previous. There were a number of other reports, however, which had been previously passed by the standards committee and which were favorably acted upon by the membership at large.

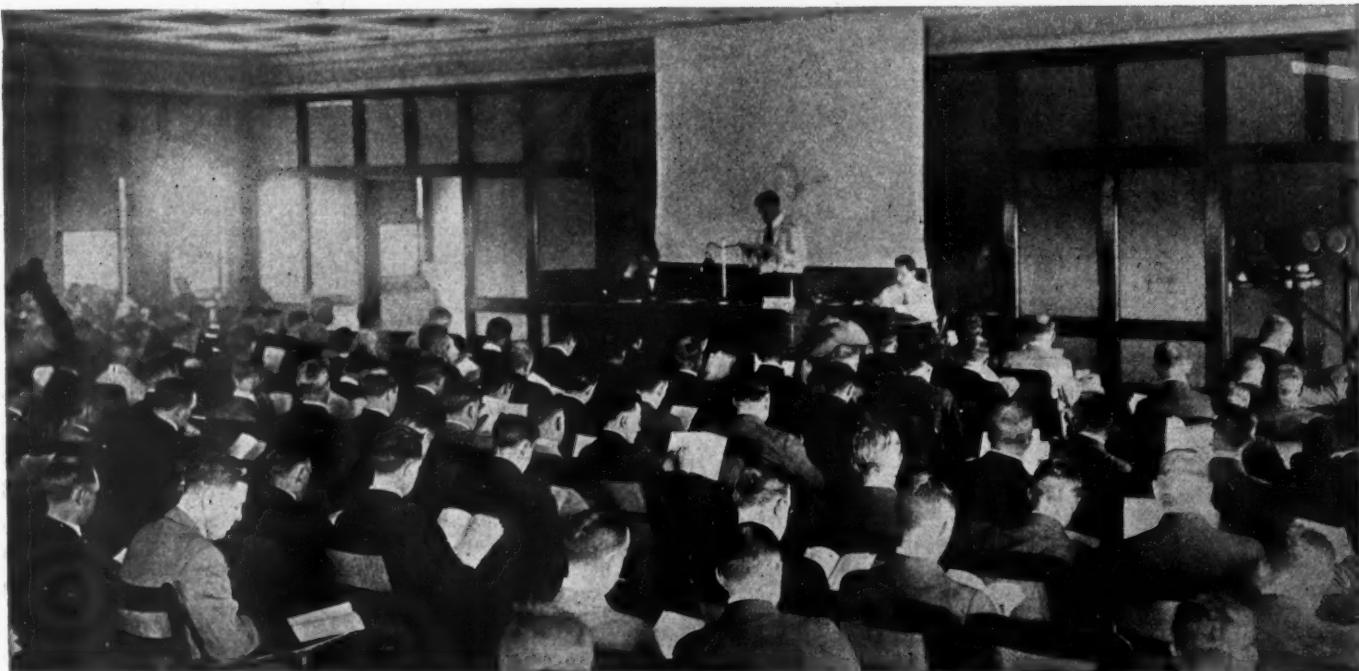
The report of the aeronautic division, which is of a highly detailed nature and which was approved by the committee on the preceding day, went through with very little discussion. A few unimportant clauses were referred back to the committee for revision and reconsideration, but as a whole the recommendations of the standards committee, which are highly necessary to the government in its aeroplane building program, were carried. The discussion hinged about nomenclature to some extent. Walter Allen of the Bijur Motor Lighting Co. asked that the name dep. control be kept instead of column control. It was explained by Standards Recorder Woodbury that Admiral D. W. Taylor had made objections to the name Deperdussin, from which the name dep. control has been taken. The entire matter was referred back to the nomenclature division.

Engineer Rody of the Champion Spark Plug Co., Toledo, questioned the plug size, as he stated that it does not allow



Glimpses of S. A. E.

Summer Meeting



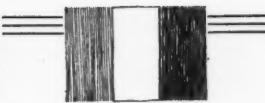
Society of Automotive Engineers members in professional session in the Bureau of Standards Building in Washington June 25-26



**WING COMMANDER
I. W. SEDDON**
of the British Commission



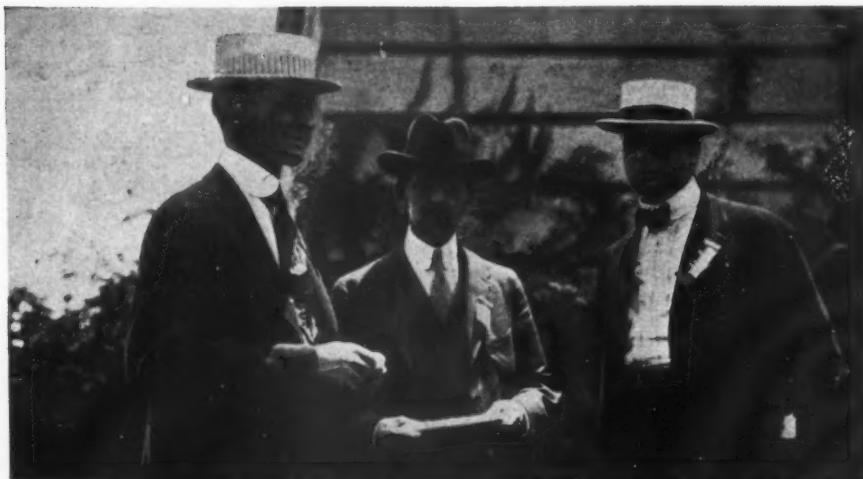
Members of the Society of Automotive Engineers registering on their arrival at the Bureau of Standards in Washington



**LIEUT. AMAURY
DE LA GRANGE**
of the French Commission



Lieut. Amaury de la Grange, of the French Commission, addressing an overflow meeting of over 100 S. A. E. members and their guests



J. G. VINCENT
Working on Aero-
nautics at Bureau of
Standards

C. W. MANLY
Chairman Aeronauti-
cal Division, S. A. E.

W. OWEN THOMAS
Author of paper on
army truck design



HENRY R. SUTPHEN
Author of paper for S. A. E. Summer
Meeting on submarine chasers

of the use of the standard hex stock. Chairman Utz stated that the metric standard had been adopted in order to facilitate the changing of plugs in the machines that are used on the other side. The point was brought up, however, that in view of the importance of this work the entire spark plug recommendation should not be discarded merely for the size of the hex, and B. B. Bachman of the Autocar Co. made the motion that the report of the aeronautic division be accepted with the exception of the paper on the magneto shaft, the name of control and the spark plug hex dimension. This was carried unanimously and the points referred to turned back to the committee for future consideration.

Metric Sizes Discussed

George R. Bott moved that the ball and roller bearing division report be accepted with the exception of the metric sizes. R. McA. Lloyd asked why they should be referred back and it was explained by Mr. Bott that the establishment of metric standards was of international importance due to the use of metric sizes abroad and at this particular time, owing to the disruption on account of the war it would be inadvisable to make any standards which would later embarrass the foreign ball bearing manufacturers. The exception referred only to the standard metric sizes for thrust ball bearings of the flat face type and the self-aligning type with washer. It also takes in the metric sizes for thrust ball bearings, steering knuckle type but not the other bearing sizes mentioned in the report. This recommendation was adopted by vote and the report of the committee was carried with the exception of the parts referred to.

Reports of the chain division dealing with the pitch and width of silent chains; the data sheet division dealing with the classification of the handbook; the electrical equipment division covering flange mountings for generators, starting motors and ignition distributor mountings; the engine division covering poppet valve dimensions; the iron and steel division giving the temper of sheet steel classifications, and the miscellaneous division, were all carried without discussion.

The report of the lighting division dealing with automobile lighting terminology was carried with the addition that the voltage classifications for batteries have been standardized as 6-8 for three cells, 8-10 for four cells, 12-16 for six cells and 18-24 for nine cells. Spherical bulbs for headlights shall have a minimum diameter of $1\frac{1}{2}$ in. and a maximum of $2\frac{1}{16}$ in. Side bulbs shall have a maximum diameter of 1 in. and instrument lamp bulbs a maximum of $\frac{3}{4}$ in. With these additions the report was adopted.

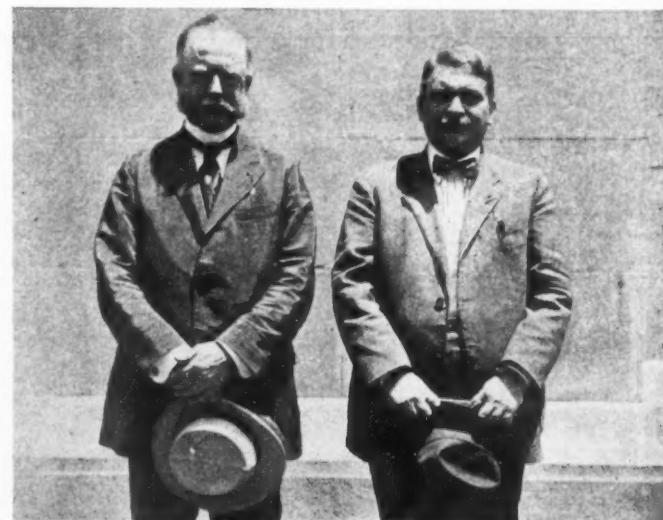
A short discussion was given on the report of the research division by N. W. Akimoff, who questioned the advisability of establishing a uniform basis for all tests by ruling that there be no change in gear ratio, ignition, carburetor or any other detail of the car or its equipment. This was the only point raised, however, and the report was carried.

An alteration in the report of the starting battery division,

as approved by the standards committee, was made at the general society meeting. The report included a mention or recommendation of the location of the battery. This was thought to be inadvisable and all mention of the point at which the battery is to be situated on the car was withdrawn. The manner in which the battery is to be fastened was left as it stood. C. W. McKinley stated that it was the experience of the Overland company that the battery is better located in the body than on the chassis on account of mud and on account of the greater ease in giving it the proper attention. With the exception noted the report was adopted.

A slight alteration was also made in the report of the tire and rim division, which furnished a table of carrying capacities and inflation pressures of pneumatic tires. The printed table gave the inflation pressures as maximum, and this word was altered to read corresponding, so that the headings on the table now give the size of tire in inches, the maximum load in pounds per tire and the corresponding inflation pressure in pounds per square inch.

The report of the tractor division was accepted without discussion except regarding the point of tractor speed. This was given in the original report as shown in the account of the standards committee meeting as being $2\frac{1}{3}$ m.p.h. It was first suggested that this be altered to read "For tractors of four plows or less." This was again amended and in its final form the speed now stands at $2\frac{1}{3}$ m.p.h. for tractors having 15 drawbar hp. or less. Mr. Horning pointed out that the speed is necessary in determining the curve of the mold boards of the plow.



HON. W. C. REDFIELD
Secretary of Commerce

DR. STRATTON
Chief of Bureau of
Standards

Standards Committee in Record War Session

Accomplishment Is Keynote of Gathering of 300 Engineers—Automotive Activities Are Features—Discussion of Constructive Nature—Ten Division Reports Accepted

THE 1917 summer rally of the standards committee will go down in the history of the Society of Automotive Engineers as the most notable and most successful it has ever held. The need for efficient action in work which has an important bearing on the war work of the country called forth a spontaneous gathering which set a new record for attendance at a standards committee meeting. The 300 engineers present were moved with a spirit of accomplishment which was gratifying in the extreme and red tape and quibble were swept aside as many important points which will clear the way for quick production in automotive industries were decided and passed along for final action.

One of the most noteworthy points in the meeting was the fact that the society has broadened into its automotive field. Aeronautical and tractor standards occupied the attention of the committee as much as, or more than, standards for automobiles. The members of the aeronautical division, as well as the members of the tractor, made urgent pleas for immediate decisions, showing clearly that the society has stepped into fields where its activities are sorely needed in standardization work. The most gratifying feature of the meeting was that this action was forthcoming, and reports which will be the fundamentals of production in both these industries were passed along for action by the council and by the membership at large.

The reports which indicated definite progress and which were accepted by the standards committee were those of the aeronautic, ball and roller bearings, data sheet, electrical equipment, engine, iron and steel, lighting, miscellaneous, starting battery and tractor divisions. All these were gone through during the day's progress, and in addition Secretary of Commerce Redfield delivered an address of welcome which carried home to the engineers present a message of the importance of the work of the technical brains of the country.

Most of the reports which were accepted in the standards committee meeting to-day carry definite recom-

mendations for standards which will be accepted by the general membership to-morrow. In all senses it was a meeting of progress, and the society is to be congratulated on the way its engineers went through the schedule, particularly at a time when this work is so important.

It was pointed out that there is no specification for the 5/16 loop end and in reply to this Mr. Manly stated that it purposed to fill in the missing sizes later and in the meantime the division had gone ahead with as many sizes as possible.

Details Closely Studied

In regard to the turnbuckles specified, those which are described have been used by the Curtiss company for the past 2 years. All the details of the turnbuckles are not settled, Mr. Manly explained, but the main dimensions, such as that between the eyes, are covered. There is also a table of strengths of the turnbuckles mentioned in the report. General figures were also given by Mr. Manly in sufficient detail to cover present needs on a number of other detail aeroplane parts. Some of the other parts taken up were shackles, clip ends, clevis pins, bolts, nuts, magneto bases, which are the same as the French standard, except that metric dimensions are replaced by the corresponding inch sizes. The thread size is not recommended at the present time.

W. A. Frederick, chief engineer, Continental Motors Co., presented the report of the electrical equipment division which had been referred back to the committee after the Cleveland meeting. The discussion on whether or not a pilot flange should be fitted again came up, but after some debate the report was accepted by the committee as it stands. Those entering into the discussion were C. S. Crawford, engineer of the Premier Motor Corporation; Joseph Bijur, president of the Bijur Motor Lighting Co.; W. A. Chryst, of the Delco Co.; F. L. Morse, of the Morse Chain Co., and V. G. Apple, electrical engineer.

The report was finally accepted as printed and passed on to the meeting of the entire society.

Standard Size Battery Containers

The report of the battery division which recommended standard dimensions for containers was accepted entirely,

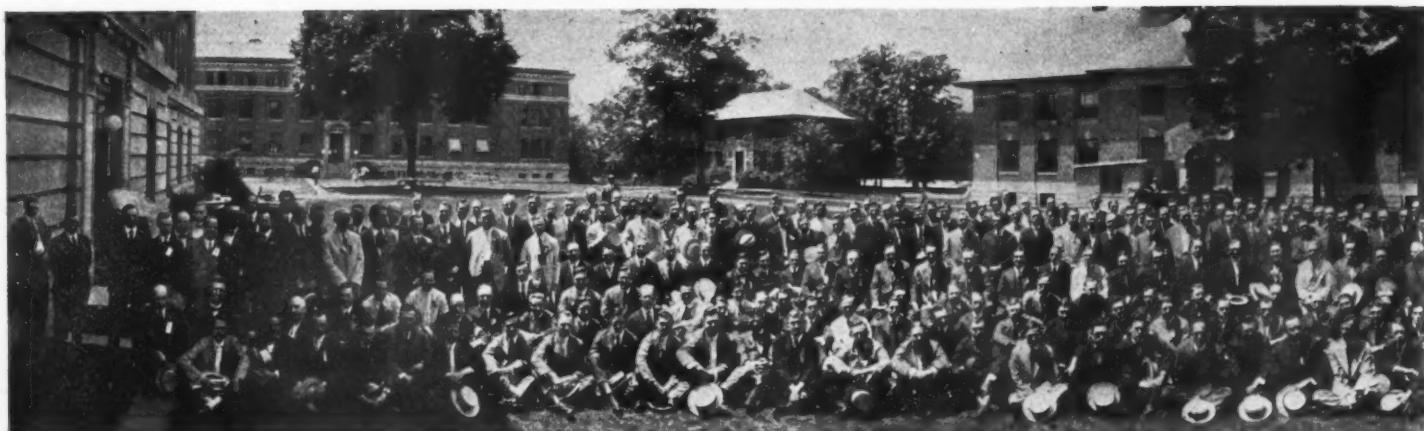


H. L. HORNING
In charge of farm tractor work of
the Council of National Defense



J. G. UTZ

Chairman standards committee of the Society of Automotive Engineers. Mr. Utz is chief engineer of the Standard Parts Co., Cleveland



Members of the standards committee of the Society of Automotive Engineers gathered outside the Bureau of Standards

except for the recommendations covering battery location which were left open. Considerable discussion took place on this point, as several members called attention to the objections of various locations. About the most pertinent of these dealt with the necessity of keeping the battery away from the heated air of the engine and exhaust pipe on account of the necessity for frequent renewal of the water.

The reports of many of the divisions were accepted without discussion. On others, however, there were points raised. A feature of all the discussion was its highly constructive nature.

Aeronautic Report Important

Probably the most momentous report of the entire program was that of the aeronautic division presented by C. W. Manly, engineer of the Curtiss Aeroplane Co. This report covered many of the points which were brought up at the Cleveland meeting April 3, but goes much further into detail. The points touched upon are column control, stick control, thimbles for wire ends, marking of fuel pipe lines, marking of lubrication lines, marking of air pipe lines, basic system of measurement, besides the points which have been taken up at a previous meeting, and all of which were presented at the general society meeting on Tuesday morning for final action.

Some discussion developed on this report, particularly on the method of marking the various pipes. It was suggested that marine practice be followed, but when a comparison was made with the available usage in the navy department it was found that this was impractical, and the matter was allowed to pass.

The word "lubrication" was substituted for the word "oil" and the pipe was described as the lubrication pipe instead of the oil pipe, to avoid any possible confusion with the fuel line. This part of the aeronautic report was carried with the amendment covering the change of wording.

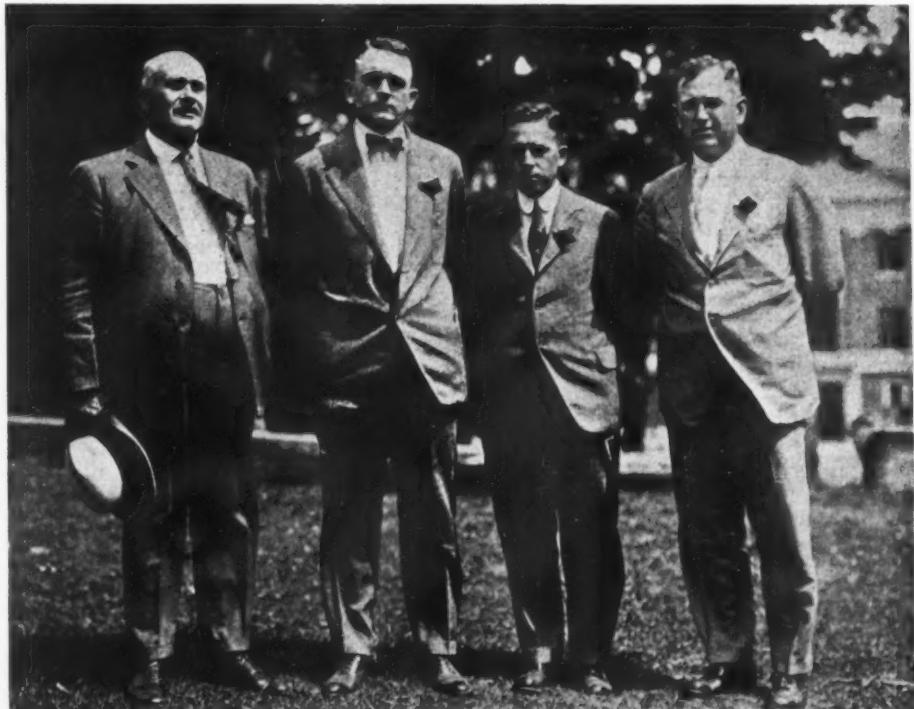
Mr. Manly took up each of the points in the aeronautic report as he went along, and described how the division had reached its conclusions. A large part of this was confined to figures, but a significant point was that all the dimensions practically were taken from those which have

proved to be of practical service abroad in the aeronautical work in the allied army.

One of the details dealing with the hard wire ends showed a slight difference in practice here and abroad. Mr. Manly stated that on this side the engineers generally favored a soldered end, while on the other side they did not. An important point is that the temper of the wire must not be drawn either by a flame, by the soldering bath, or any method of applying the solder.

New Series of Thrust Bearing Sizes

At its Cleveland meeting in May the standards committee approved three series of metric ball-thrust bearings, viz., flat face, self-aligning and steering knuckle bearings. These have now been supplemented by four other series of thrust ball bearings in inch dimensions, viz., flat-face light series, flat-face medium series, self-aligning medium series and self-aligning light series. In presenting the report of the ball and roller-bearing division, Chairman Hughes said that these new series of inch size thrust bearings, while not in use at the present time, have the approval of all the bearing makers. When the matter was put to a vote by the standards



J. W. GRAY
Gray Tractor Mfg.
Co.

FRED GLOVER
Emerson-Branting-
ham Co.

P. H. GREER
Greer-Robbins Co.
H. L. BRUNGER
Aultman & Taylor
Machinery Co.



building in Washington during the Summer meeting of the society and photographed at the close of an active session

committee, each series being considered at a time, all were approved without opposition. The four new series will be published in a later issue.

Extension of Rod End Standards

E. H. Ehrman, Chicago Screw Co., presented a report for the miscellaneous division. This contained a proposal for an extension of the recent standards for rod ends, together with a revision of the limits on drilled holes and pins and an increase in the length of the $\frac{1}{2}$ -in. adjustable yoke end. This division has also done some preliminary work with a view to standardizing the sizes of shop drawings. An inquiry was made to determine present practice and a plot was shown giving the different sizes of sheets in use in a horizontal column, the names of makers in a vertical column, and the squares corresponding to each maker and the sizes of sheets used by him were blackened, so that the relative popularity of the different sizes could be seen at a glance. It was found that 9 by 12 in. is a very common basic size, but the division believes that it will be preferable to use the common letter sheet size, $8\frac{1}{2}$ by 11, for the basic size, as drawings can then be conveniently filed in letter files. By using this size there would be no great cutting waste in either the tracing cloth or the blueprint paper. The adoption of this system would give the men in the shop a chance to file their drawings. The half-size sheets, $5\frac{1}{2}$ by $8\frac{1}{2}$, would be very convenient for shop handbooks. Mr. Ehrman explained that the matter had only just been taken up and as no action had been taken on it by the divi-

sion, he wanted to bring it to the attention of the committee at the present time so they could give it some thought and would not turn it down point blank upon its recommendation later on because the present popular size was 9 by 12 in.

Closer Limits for Rod Ends

Taking up the new tables for yoke and eye rod ends, B. B. Bachman, Autocar Co., asked whether there was not an unnecessary use of the $1/64$ -in. dimension in the table on rod end pins. This point was cleared up by Mr. Ehrman. H. A. Goddard, Perfection Spring Co., voiced the opinion that the size of the drill hole for the pin in the yoke end was limited too closely. He pointed out that the average drill gave an oversize hole, and suggested that the limits be made plus 0.003 in. and minus 0.001 in., instead of the plus and minus 0.001 in. provided for the smaller sizes and plus 0.001 and minus 0.002 for the larger sizes. Mr. Ehrman replied that they had had a good deal of argument on this point in the division and had finally decided to put the limits fairly close, indicating a rather high grade of workmanship. The limits suggested did not represent snap judgment, but were arrived at as the widest permissible after an extensive investigation had been made. Mr. Goddard suggested separate limits for drilled and reamed holes. W. C. Keys, Perfection Spring Co., agreed with Mr. Goddard on the necessity for larger limits, and the argument was made that inasmuch as these yoke connectors are often under spring tension, a hole $1/64$ in. oversize would do no harm. The suggestion of a clearance of this order aroused considerable merriment. A motion to accept the report as printed was carried.

After the morning session, which was adjourned about 1 o'clock, the members and guests formed a semicircle on the lawn between the different buildings of the Bureau of Standards for the panoramic photograph, reproduced on these pages. After this had been taken, lunch was served on the lawn. It was announced at this time that after the adjourned session in the afternoon guides would take the visitors through the different departments of the Bureau of Standards and explain the work of the bureau.

Standards for Hand Starting Cranks

Professor Fishleigh presented the report of the engine division. This dealt with six subjects, as follows: One sub-committee, of which H. L. Horning is chairman, was appointed with the object of formulating standards for hand starting cranks. Data on this subject were gathered and a tentative recommendation made which had now been submitted to manufacturers for their criticism. Another sub-committee, of which A. F. Milbrath is chair-



C. W. MCKINLEY
Willys-Overland Co.

E. H. EHRMAN
Chicago Screw Co.

man, is considering the standardization of engine supporting arms for both straight and tapering frames. Information is still being gathered, and only a report of progress could be made. Fan design was also referred to a sub-committee. Engine characteristic curves are being gathered by the division. Now that the test forms have been finally standardized the division is in a position to gather strictly comparable data along this line covering a wide range of application of internal-combustion engines. V-belts is another subject under consideration by this division and a report on an extensive series of tests is expected shortly. Finally, the division for some time had been working on the standardization of poppet valves and had finally agreed upon a set of dimensions for from 1 to 3 in. effective diameter. A similar report was made by the division to the committee at the May meeting but was referred back on account of some criticism of the stem sizes of valves, which were considered inadequate. In the meantime the division had gathered data on the use of these large-size valves in airplane, marine and other engines, and these data showed a clearly defined tendency to use a stem of $\frac{1}{2}$ -in. diameter for valves of effective diameters of $2\frac{3}{4}$ and 3 in. The report of the division recommends that the nominal valve diameter shall be the port diameter P . The corresponding actual valve diameter and the stem diameter are given in the accompanying table. The limits for stem diameters have been selected so as to give proper clearances in guides reamed with commercial reamers. A slot is specified for valve grinding tools to be $3\frac{1}{32}$ in. wide, and made with a cutter having a $1\frac{1}{4}$ in. radius. The depth of the slot is not specified on account of the varying shape and thickness of heads. The matters of valve material, spring length, form and pressure and spring washer support are left open.

The only part of the report of this division which was ready for action by the committee was that relating to poppet valves, and this was approved by the committee.

Lighting Division Report Accepted

W. E. McKechnie, Cadillac Motor Car Co., made a long report for the lighting division which was accepted. It contained numerous new definitions of terms, some arrived at after consultation with the Illuminating Engineering Society, and various technical recommendations. The lamp voltages of generator lighting systems are to be rated as follows in future for different numbers of cells:

3 cells.....	6- 8 volts	6 cells.....	12-16 volts
4 cells.....	8-10 volts	9 cells.....	18-24 volts

It was explained that bulb manufacturers required these data in order to be able to make their bulbs combine the highest efficiency with long life.

Tractor Division's First Report

Fred Glover, Emerson-Brantingham Co., read the first report of the new tractor division. He stated that in attempting to standardize parts of motor tractors much difficulty had been encountered for the reason that the tractor manufacturers were not accustomed to this sort of work and some refused to give the necessary information regarding their practice. The first thing it was decided to standardize was methods of rating. At present tractor makers rate their products in widely different ways. It is suggested that a double rating be used, the belt power rating and the draft rating. The former is to be 80 per cent the maximum belt load the tractor will carry continuously for 2 hr. and the latter 80 per cent of the draft load the tractor will carry continuously for 2 hr. when the footing be specified, because if the

tractor cannot get any footing it cannot haul and load at all. A result of the adoption of these two rating rules will be that all manufacturers will have to lower their rating.

Another thing considered for standardization is belt speed. This factor now varies all the way from 1500 to 3300 ft. per min. In deciding upon a proper figure for belt speed which will determine the size of pulley to provide on any tractor, the requirements of separators (threshing machines) were kept in mind. The figure decided upon was 2600 ft. per min., which corresponds very closely to the average belt speed of steam traction engines used for threshing.

The third factor to be standardized was height of the drawbar. This was placed at 17 in., and in deciding upon this factor consideration was given to the very pronounced tendency to cultivate the soil more deeply and also to the fact that on many tractors one of the wheels runs in the furrow and has a tendency to tilt the whole tractor.

Standard Plowing Speed 2 1/3 M.P.H.

A standard plowing speed of 2 1/3 m.p.h. was agreed upon by the division. This factor is a very important one for the reason that farmers are accustomed to judge a tractor according to its drawbar pull or the number of bottoms it will pull, and naturally the drawbar pull is less the greater the speed, so if the speed is not defined there is a chance to misrepresent the capacity of the machine.

All the S. A. E. magneto dimensions have been adopted as standard tractor practice. The magneto shaft is to be of 0.750 in. diameter and the coupling is to be held in place by a key and pin, the dimensions of which are to be determined later.

The above are items on which definite action had been taken by the division and regarding which the approval of the committee was asked. Other subjects regarding which only progress could be reported were the standardization of rim punchings for lugs, specification forms, carburetor fittings and standard tractor couplings. Different forms of lugs are required under the widely varying conditions under which tractors are used. It is believed that the standardization of the fastenings of these lugs will encourage development of lug design, for with standardized fastenings, if any, one should develop an important improvement in lugs. He would have the chance of fitting it to any and all tractor wheels instead of merely to the particular wheel for which it was designed. Thus the reward offered for such improvements is multiplied manifold.

Standardized Coupling Is Essential

A standardized coupling which will permit of hitching any agricultural machine up to any tractor is very essential. The division will also ask the standards committee to extend its ball-and-socket joint and yoke and rod end standards to include sizes suitable for tractor work. Standard nomenclature for tractor parts has also been considered. In this connection Chairman Utz pointed out that the nomenclature division has power to call to its assistance members of other divisions when considering the nomenclature of particular branches of the industry.

H. L. Horning, in commenting on this report, said that it covered items which are fundamental to the tractor industry, points that had given the makers of tractors much bother for years. He hoped that the report would be shot full of holes if possible so that when it was passed we would have something which might stand for years. The report was accepted as read.

Deeds Outlines Aircraft Board Activities

Secretary of War Baker Also Emphasizes Importance of Airplanes in Address at First Dinner of Automotive Engineers

THE summer meeting dinner of the Society of Automotive Engineers was held in Washington, D. C., Tuesday evening, in the grand ballroom of the New Willard Hotel. More than 700 members and guests sat down to the tables. In a brief introductory address, President Dunham said that it had been customary to hold two annual meetings of the society to discuss papers and to get together in a social way. The present summer meeting was distinctive in two ways, in that it was the first meeting held since the formation of the new Society of Automotive Engineers, and in that our country was now engaged in a deadly struggle in which the society would take a most active part. It would be a war of internal combustion engines largely, and all the different activities of the society would come into full play. The aeronautic section of the society had been at work for more than a year. Several of its meetings were held at the Bureau of Standards, and much co-operation was extended by all departments of the Government. The society now also incorporated a tractor section, and work on the standardization of tractor parts had already begun. A monumental task was accomplished by the society in co-operation with Government officials in drawing up very complete specifications for two sizes of army trucks.

Toasts to Our Allies

Judge W. Benton Crisp, who was counsel for the Ford Motor Co. in the suit which led to the overthrow of the Selden patent, acted as toastmaster. Toasts were proposed successively to the President of the United States, the King of England, the Republic of France, the King of Italy, and the Provisional Government of the Republic of Russia, and as each name was mentioned the audience rose and the band played the national anthem of the particular country. Toastmaster Crisp referred to his connection with the Selden suit, and said that he hoped within a short time also to release the airplane industry from the same patent thralldom from which the automobile industry had suffered years ago. Airplanes, he said, would be of immense value in the present war. It was appropriate to recall that the airplane had its origin in the city in which the dinner was held. The experiments of Samuel Pierpont Langley concededly formed the inspiration for the Wright brothers. The greatest credit belonged to Langley, and the speaker said he wished that the audience could proceed to the little mound which marked the grave of Langley and place upon it that wreath of honor which should properly have been given him during his lifetime.

The toastmaster then introduced the chief speaker of the evening, Secretary of War Baker, who had only just arrived. Giving a brief résumé of the secretary's career, Mr. Crisp said that no Secretary of War ever had to deal with any more complex and difficult problems than he had, and when the history of this war was finally written it would be shown that Newton D. Baker acquitted himself creditably.

Secretary Baker started out by saying that on a number of occasions he had tried to address scientific societies, but he always felt much embarrassed, for the reason that he had no scientific instincts and had had no scientific training. However, at every turn in life he had had occasion to become impressed with the great importance of science. The United States was now engaged in war, and a twentieth century war it was. War had evolved from the time when the first aborigine aimed his first stone at his fellowman to the present time, when wars were being won by the most ingenious, subtle and scientific people in the world. When the history of this war is finally written it will be shown that we won because we were able to contrive more ingenious engines than our adversaries. War used to be waged on level plains, but to-day it was fought out in the air, on the surface of

the land, on the sea, and below the surface of the water. In the beginnings of warfare, in single combat, the struggle ended when one party was killed; and in the earliest wars the loss in men usually amounted to 40 or 50 per cent. Later, when improved implements of warfare were introduced, it was possible to engage larger bodies of men in battle, but the percentage of loss constantly decreased. What the outcome of this war would be, said Secretary Baker, could not be exactly foretold, but he hoped that this tendency toward decreased proportional losses would still continue. In order to reduce the percentage of our own losses we would have to make use to the fullest possible extent of all the appliances which modern science affords. Airplanes would be a great aid in this connection. What we must do was to make better and more airplanes, so that we can see where our adversaries cannot see. Engineers building airplanes should realize that they are as truly winning battles as though they were engaged at the front.

An interesting address was made by Edward A. Deeds of Dayton, Ohio, chairman of the Airplane Construction Board. Mr. Deeds said that some time ago he received from Howard Coffin a telegram asking him to spend a few days at Washington. He had been there now for 3 months, and his stay might possibly be extended to 3 years. He had become used to everything in Washington except the climate, and it was hotter that night than ever before.

Mr. Deeds gave some information regarding the activities of the Aircraft Production Board, which was organized on May 6 last. It consisted of four civilian members, namely, Howard Coffin, Sidney D. Waldon, Mr. Montgomery and Edward A. Deeds, and of one representative each of the Army and Navy—General Squires and Admiral Taylor. It was the policy of the board not to create any new machinery of administration but to mesh into the machinery already existing at Washington. As a result of the work of the board during the past 5 weeks, there had been formed so far eight cadet schools at various universities in the country, at which were offered 8-week courses on the principles of aviation and military tactics. Every Monday morning twenty-five young men started at each school. So far, work on four large aviation schools has been started, at Dayton, Ohio; Chicago, St. Louis and Detroit. At Dayton over 3000 men are at work on a tract of 2500 acres, which included the original flying field of the Wrights, of 80 acres, with a solitary hangar. Eventually there would be a row of hangars at Dayton 1½ miles in length.

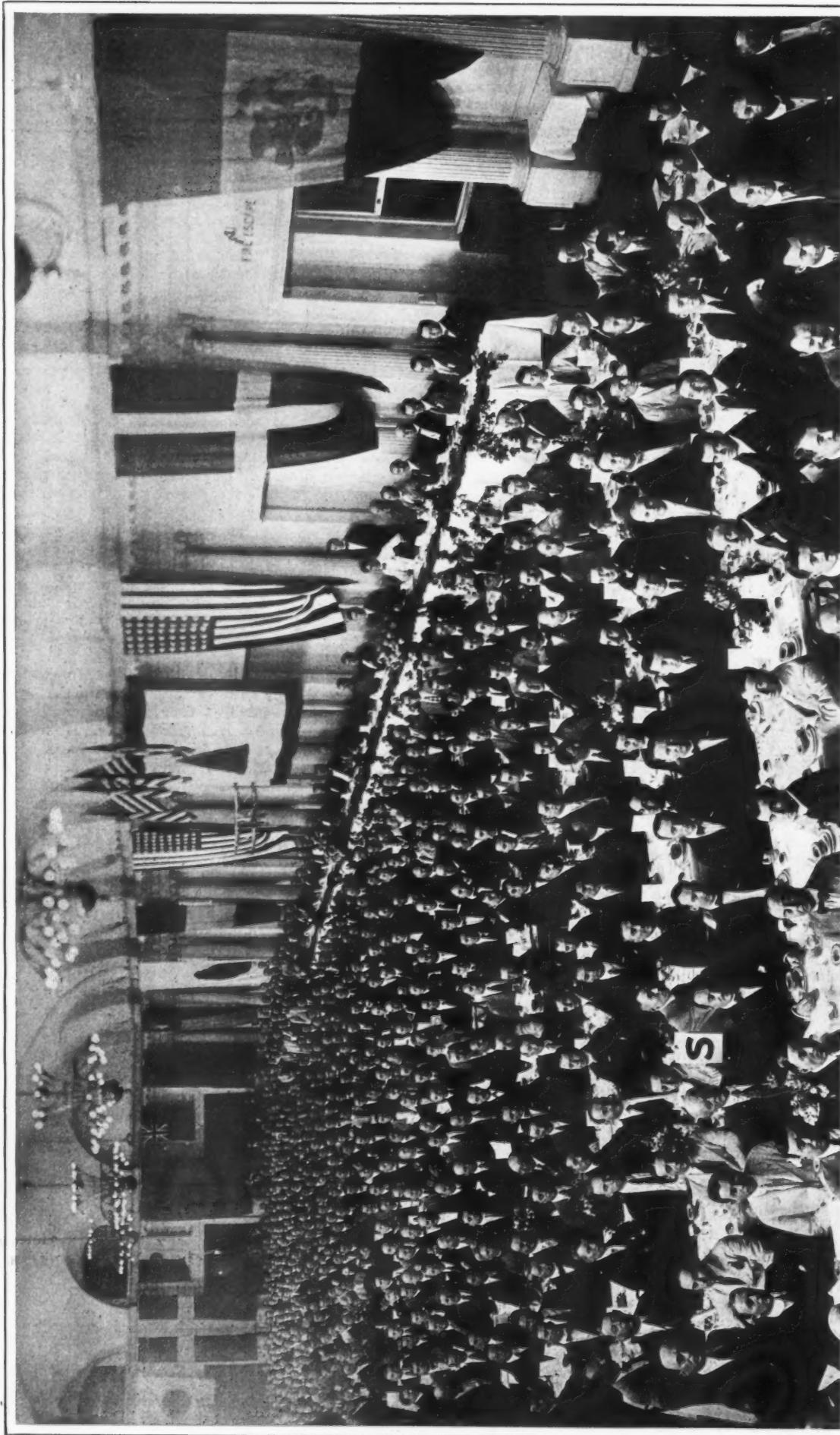
Two Types of Training Planes

Two types of planes have been laid down for primary training, and 2000 of these will be ready by Jan. 1. Some advance training is also to be given with combat machines or battle planes. A short time ago 100 of the best mechanics from the different automobile factories of the country were sent abroad to study the construction of airplane motors in foreign shops. They were accompanied by 10 men in charge of the expedition. The board had its choice of three methods of procedure, and all three would be employed at the beginning. First, it could develop and continue the existing types of airplane engines; second, it could get designs from abroad and duplicate these; third, it could develop a new American design of engine, and work along these lines was proceeding at the Bureau of Standards.

There were a number of other speeches, including one by Colonel Seddon of the Royal Flying Corps.

An interesting feature of the dinner was a book of patriotic songs, decorated with sketches of motorized war implements of different kinds, which was distributed by the Gurney Ball Bearing Co.

First Dinner of the Society of Automotive Engineers



Photo, by R. S. Clements, Washington, D. C.

THERE were 700 members and guests of the Society of Automotive Engineers at the first dinner of the Society under its new name and in its enlarged form. This informal gathering took place in the Grand Ball Room of the New Willard Hotel in Washington, on Tuesday evening, June 26, being one of the important features of the annual midsummer meeting of the Society. Details of the addresses given by Secretary of War Baker, E. A. Deeds, of the Aircraft Production Board, and others, appear on page 1203.

To Standardize Army Truck Details

Principal Components Will All Be Interchangeable—
Great Aid To Chassis Assemblers—Small Outputs Rendered Valuable Because All Vehicles Will Be Identical

IT is now certain that the specifications for military motor trucks will be far more accurate and detailed than the original draft published recently. By the end of this year, possibly earlier, there will be machines coming through the factories which will be entirely standard with respect to the interchangeability of the principal components. Engines, transmissions, axles, springs, radiators and even frames will be so closely similar in external dimensions that one will be replaceable by another.

This does not hamper originality of design as regards the inner details. In the case of the engine, for example, what is wanted is a standard location of the bearers relative to the crankshaft center, a standard transmission coupling, a standard place and size for each water-pipe attachment, and so on. In the case of a manufacturer who assembles his chassis this means that any source of parts supply can be used indifferently. If one transmission maker fails to live up to his promises, another can supply a "different" gearset which will fit perfectly.

Object Is Two-Fold

The object of the War Department in encouraging this sort of standardization is two-fold. It is an accepted fact that an army cannot use fleets of vehicles composed of all sorts of designs without great difficulty. The more the army has of absolutely one design the better, provided that design is right. It is not possible immediately to purchase anything but regular commercial products. These can only be obtained in quantity from a number of manufacturers. In emergency, such as the present, it is only practicable to give orders to makers who can supply rapidly sufficient machines to enable convoys to be composed of one-design trucks. This means not less than 1000 of each. To broaden the source of supply, it is essential that the smaller makers be enabled to produce trucks so nearly alike that they can be grouped in quantities of 1000 or over with the same facility that the one-design trucks from larger makers can be grouped.

With the parts makers all in line, so that their engines, axles, etc., will interchange, it makes no difference what is the capacity of the assembler's plant. If he can only turn out a couple of chassis a week his output is still worthy of consideration, because each of his trucks can be grouped with others from similar small sources of supply and still have the whole fleet possessed of requisite interchangeability.

Insures Maximum Supply

The scheme provides the government with the largest possible market to draw upon; the industry gains in that nobody is too large or too small to be outside consideration. It has an additional advantage, that it does not limit originality of detail design, for though a dozen engines may be all of the same piston displacement and all such that they will fit the same chassis, still they can be individually different in every essential portion of the design. An engineer who is able to produce a better engine than the average for its size will have opportunity to

show his powers, and an improved manifold, an improved valve layout, a better lubrication system will be capable of application without restraint.

Matters reached the present stage by the manufacturers' realization that stock parts now obtainable would suit the military requirements in only a few instances. Not many engines were the right size, and the big engine is one of the things most insisted upon by the war department. There were very few four-speed transmissions, and they did not give the required ratios, another point of insistence. So altogether it was made clear that a number of new parts had to be designed if the assembling chassis makers were to obtain their due share of the business, and, which is more important perhaps at the present, if the army was to get a sufficient quantity of satisfactory trucks in adequate time.

There are several commercial trucks plenty good enough to use, but none that could not be made still better for military work. Thus the plan of the board is to use the existing machines for first supply, making full use of the facilities existing, and to have later supplies of exactly what they would prefer to get in course of making while the first orders are being delivered. In a word, the getting together of the industry to make parts for an entirely military vehicle is just a substitution for each parts maker working for himself and producing something just as new as he will now make, but without the enormous advantage of interchangeability with other similar chassis units.

Dimensions To Be Determined

The details are still not quite settled. Captain Britton has prepared drawings of a chassis with the location places marked, deriving the dimensions from the conferences of last week. This layout is to be discussed still more, and it is probable that the standardization of what might be called "main" dimensions will be carried still further.

In this work the frame is the basis. It must have supports for the engine, the transmission and the springs at certain fixed places, and it must have a steering-gear attachment which will not interfere with the other units. The frame itself can be either pressed steel or channel and of all sorts of sections, provided the locating points of attachment remain unchanged. There is some talk of using a standard channel section for the side rails, but this is quite visionary at present and not of great importance.

Given the interchangeable main units and standard couplings, add the S. A. E. standards for details like yokes and rod ends, flanges, etc., and one gets a truck which is individual only in the parts which do not often require replacement. For example, the pistons need not be all alike, because they are seldom replaced, and the same is true of valves and crankshafts, or of cylinder blocks. A replacement which involves a thorough overhaul and rebuilding at a base workshop is quite a different matter from a replacement that can be made in the field. In the field it is easiest to replace complete units, easier

to put in a complete new gearset than to put a new set of gears in an old case. Field work should not require more tools than a set of wrenches, whenever possible.

In this new scheme the parts makers are co-operating with the war department in a way that is deserving of the very highest appreciation. It is not only the war department which has cause for gratification, nor the S. A. E., whose committee work has brought this thing to pass. Those who will benefit most are the assemblers of chassis, and through them the parts makers them-

selves. Above all, perhaps, the thing which will stand out when viewed from the distance of years to come will be the fact that in this matter the American industry is doing something which is far in advance of anything ever dreamed of in other countries. Years of war have driven it home in Europe that by co-operation in everything, and by nothing *but* co-operation, can this war be won speedily. America is starting to co-operate to the limit in many ways, and in none more than in this particular matter.

Many Army Truck Body Types

War Department Plans To Divide Trucks Into
Convoys on Same Chassis—3% To Be Auxiliaries

THE drawings of the military transport bodies for trucks class A and B which were published in THE AUTOMOBILE last week represent only one of many kinds which will be wanted. There will be required many more of the transport, or stake bodies, than of any other sort, but there will be large quantities of other styles as well.

A truck convoy usually consists of about thirty vehicles. With this number will go a repair truck, equipped for roadside repair work and simple jobs, an officers' truck with a body which is part passenger-carrying and part office, and one or more kitchens; also a gasoline tank wagon and perhaps some others.

It is the present plan of the War Department to divide up its trucks into convoys consisting of only one chassis, so that the auxiliaries will be mounted on the same running gear as the transport bodies. The exact nature of the convoy depends, of course, upon the length of the haul. On short runs the repair shop and the kitchens would not travel. None the less, the proportion of auxiliaries to transport trucks will probably be in the order of 3 per cent.

Special Bodies for Odd Purposes

In addition there will be some special bodies for various odd purposes and, of course, ambulance bodies. The latter are not handled by the quartermaster's department, as are the others, but come under the direction of the Surgeon-General's department. They will, however, be required for the standard chassis as well as for passenger-car fitting in smaller sizes.

Another body which will probably be a "conversion" for the standard transport body will be one for carrying troops.

Up to the present it is only the transport body that has been decided in all details. Captain Britton has elaborated the drawings published by adding details, and has cut the cost slightly. The final body has several novel features, of which the principal ones could be seen on the general assemblies. First, there are no side rails of the conventional sort. The body is carried on the series of cross beams and the floor connecting them is not clamped rigidly in any other direction. This allows the body to weave to an unlimited extent without starting any joints, for there are no joints to injure.

To give another instance, the tailboard attachments are quite novel, and the usual cross rod which forms the hinge is eliminated, the purpose being to get rid of a piece which is easily bent and rendered useless by a rear-

end bump. Then the clips which hold the tailboard in the vertical position have a link which permits latitude sideways, meaning that if the body sides bulge under the load, the tailboard can still be closed and fastened. There are no wood screws in the whole body, every junction being made by bolts, so that if a body gets loose through shrinkage or constant weaving, it is only a spanner job to tighten it up again. This body is in practically final form in every detail, and blueprints are obtainable of practically all of it.

Next will come the officers' car, which will be similarly completed in every detail in the department's office, and then the others will be cleared up in quick succession. Wherever possible the same pieces will be made to serve for more than one style of body, so that the time of getting out each should decrease steadily.

Amazon Sales Plan Brings Business

THE Amazon Rubber Co., Akron, has a plan for helping the dealer which is bound to bring results in the way of increasing business. The company spares no efforts in helping the dealer turn over his stock in the shortest possible time, and at the same time keeping his name prominently before the buying public, directing them to his store not only for Amazon tires, but for any other accessories, etc., for which they are in need.

The Amazon policy is to have one dealer only in a definite territory. Thus the dealer is assured of getting the full benefit of its advertising assistance. A line of effective advertising material is furnished the dealer free. Only sound, progressive dealers are selected, and as soon as his stock is in, the parent company lays out and follows through consistently a concentrated advertising campaign which covers only the dealer's territory. As the dealer's name is always connected and interwoven with this advertising, it brings him more actual business than could be secured in any other way.

Direct Mail Backbone of Advertising

Direct mail is the backbone of the Amazon concentrated advertising. A series of strong sales letters are written on stationery lithographed in four colors, and at the same time backed up with newspaper advertisements, outdoor display, publicity, etc. All of the expense is taken care of by the parent company. In connection with the letters, lithographed mailing cards, in colors, with the imprint of the dealer are also sent.

Window displays, flange signs, pennants, and electrotypes are taken care of by the Amazon company. Sales service consists of co-operation from the home office, which sends a man to work the trade in the dealer's territory.

Industrial Supremacy and Moral Standards

America Must Demonstrate to World That All Mechanical Inventions and Ingenuity of Mankind Are To Be Used to Produce and Keep a Permanent Peace

By Newton D. Baker
Secretary of War

EDITOR'S NOTE—*The German ruling mind, said Secretary of War Baker, before the Editorial Conference of Business Papers in Washington, has become obsessed with the grandeur of industrial supremacy. It has completely lost sense of the existence of moral standards. America, when taking its place at the table where peace will be determined, must vindicate the political philosophy upon which this country has been founded by impressing upon the world that the application of human ingenuity and mind should be for the development of comfort and peace of mankind.*

M R. BALFOUR some years ago wrote an essay called "A Fragment on Progress." It admittedly began nowhere and ended nowhere, but it raised the question as to whether there is any such thing as progress, not measuring or attempting to measure the value of human achievement by physical standards, but attempting to assess the doings of mankind by their contribution to the spiritual and ideal benefit of the race. In that spirit and with his philosophical temper, he undertook to examine the question as to whether the devotion of so much of the genius of mankind to physical and mechanical invention had really produced in addition to human comforts and happiness a result at all in proportion to the outlay, and I think he came somewhat to the conclusion, though it did not end—it ended with a question mark—I think he came somewhat to the conclusion that it was very doubtful whether really mankind had much progressed, when measured by that standard. I do not know that I share that feeling, but I think the answer to that question is going to be determined by this war, as the answers to many philosophical questions are determined by wars.

Industry Converted for War

We have devoted an enormous part of the intellectual energy and the physical strength of mankind to the conquest of the forces of nature and the resources of nature. We have reached literally into the clouds and captured the greatest servant mankind ever had, and brought him down and turned him to driving our dynamos. We have reached down into the very center of the earth and taken up portions of the earth itself, and, by processes which alchemy would have regarded as miraculous, have used the very bony structure of the earth as a fuel for the production of energy to serve us in physical ways. We have taken the brain

of man and put it on the anvil of invention, and brought out all manner of physical and mechanical contrivances, inventions, aids and appliances, easing the burden of doing the physical work of the world; and yet, in the very nature of that process, of consuming the earth and converting it into new forms and agencies for service and helpfulness, the question is not improper as to whether we have not created a bigger servant than we can manage.

Now, I imagine that the inspiration of the impossible political philosophy which at present seems to govern the German Empire is born of industrialism. I suspect that the motive of the Pan-German movement, the Berlin-Bagdad movement, the Bagdad Railroad controversy—I suspect that practically all of the major things that have been involved in that diplomacy of middle Europe for the past twenty-five or thirty years—are based upon industrial aspirations and ambitions, and if we look at it with perfect calmness, I think we can say in an uncritical or, at least, in an unblaming spirit, that the German ruling mind has become so obsessed with the grandeur of industrial supremacy that it has completely lost sense of the existence of moral standards.

When Moral Balance Is Disturbed

You and I know many Germans. Many of them have been our personal acquaintances and our friends, and a more gentle and more neighborly and more kindly and orderly set of acquaintances none of us ever had. It is not in their nature to spread poisoned candy and to poison wells, and to commit assassination, as a process of war upon the sea; it is no more a part of their nature than of anybody's else to resort to barbarity; but when the great obsession comes, when the nervous energies of a people are devoted for a continuous number of years to the idea of mechanical and industrial supremacy, and the moral balance is lost or withdrawn, then the results we witness occur.

Washington differs from most capital cities in that it is a residential city, as distinguished from an industrial or a manufacturing city, in that it is distinctively a capital city, rather than a large and metropolitan center of a country; and yet when you come here to-day you find Washington no longer a place of beauty only and of calm dispatch of an

ordered and allotted public business, but you find it electrified with energy, you find it full of business, you find that the eyes of the business world are centered now on Washington, and all other great centers of industry and commerce and business are merely tributary or subcenters to the concentration of the business of America in this city of Washington. Now, why is that? It is because war has become a thing of industry and commerce and business. It is no longer Samson with his shield and spear and sword, and Goliath with his sling; it is no longer selected parties representing nations as champions, and in physical conflict one with the other, but it is the conflict of smokestacks now; it is the combat of the driving wheel and of the engine, and the nation or group of nations in a modern war which is to prevail is the one which will best be able to co-ordinate and marshal its material, industrial and commercial strength against the combination opposed to it.

The character of war has changed, not only in the manner I have suggested, but it has changed in the place in which it is fought. There is no longer beating of drums and marching of bands and unfurling of flags across wide areas, with men going around mountains and meeting one another and fighting upon an open plane, but so far as land warfare is concerned, it is fought by men who never see one another's faces; it is fought by the use of weapons which are trained to indirect fire, and the mathematical and scientific processes by which observation is translated in the aiming of a modern high-powered gun, filled with science and accurate knowledge; but that is only the land end. The very skies are filled with warriors now, and the under-seas as well; and so we see that at least a part of the mechanical progress which has been made by mankind has been drafted into the making of what is now called the lethal weapon of war, and here in Washington we are undertaking now to marshal the genius and the vitality and the courage of a great peace-loving people, in order that they may throw their preponderating weight as a unit in this scale and rescue peace for the world. The world must have peace. The present war is costing something more than \$60,000,000 a day in money—probably nearer a hundred million—and more than 10,000 lives of human beings a day, and every day the war continues the world is that much poorer in its accumulations, in its resources and in its men. I think that all believe that every resource was exhausted before our entry into this war took place, and I think every thinking man will agree that there is now no way to re-establish peace on this troubled and bereft planet except by the exercise of the superior force of the United States.

A Battle for Peace

So that we start into this war as the evangelists of peace; we are mobilizing the industry and the resources of the United States in order that they may secure peace for the world. Every conflict we have among ourselves, every dissent which we allow to be pressed beyond the point of the expression of opinion, which is necessary to secure wisdom, every

division which we allow among ourselves delays the achievement of the great object of this war, and it is for that reason that I address to you, as editors, these precautionary remarks. It is not possible to take the industrial, commercial, agricultural and social life of a nation of 110,000,000 people and divert them out of their normal courses without creating here and there confusion and without breaking in upon the long-established and deeply cherished habits of great numbers of men. Now, it may not have occurred to you, but the thing that human beings like the least is to have their habits disturbed. We will stand almost any other kind of inconvenience with less complaint, but just try some morning eating your breakfast in a chair that is different from the one you ordinarily eat in. Just try sitting at a different place at your own breakfast table. Try coming down the back stairs, if you are accustomed to going down the front stairs, and see whether it does not disarrange your program most of the day and give you a sense of an unusual start, or something that has happened to you that is out of the normal, and if you are not constantly asking your mind to examine and see whether the switches on your day's track are really set right.

Business Habits Jarred

The greatest asset we have is our habits; it makes unnecessary separate reasoning operations for a great variety of things which we are compelled to do daily, and it is not until we have converted an operation into a habit that it becomes an asset. Now, in this mobilization of the people of the United States we are going to jar their habits. Business houses are not going to be able to do as they used to do, many ways; workers in industrial establishments, farmers who are tilling their fields, everybody is going to be asked to give up, or, at least, to permit the temporary obstruction of some of these deeply embedded habitual modes of action and thought and, as a consequence, we are all going to be in a more or less disturbed state of mind; things are not going to be as they usually are, and so our minds are going to be filled with questions as to whether the things which are in an unusual state are in a right or a profitable state. You gentlemen are going to meet that in the trades which your journals address. Some of the reorganizations and readjustments in those trades are going to be quite fundamental and profound, and the disturbance of the line of habit and normal business is going to be difficult of rapid adjustment.

Now, if all of you here, catching the spirit of the community of enterprise, will preach to those who read your papers and who are influenced by them, and whose modes of thought are controlled by them—if you will preach to them the constant doctrine of the necessity of the sacrifice of habit, in order that there may be community of enterprise in this new undertaking, if you will just take the trouble to analyze the creaking which the machine develops in the process of readjustment, and point out in a large view how unnecessary it is that these things should be, if you

(Continued on page 1221)

Standards Will Shorten War

Only Standardization Makes Possible the Vast Supplies of Manufactured Articles America Will Produce

By A. Ludlow Clayden

THE standardization work accomplished by the Society of Automotive Engineers in the past few years is going to be a big factor in shortening the war.

Not only because the standards already created will greatly facilitate the production of the things the automobile industry will be called upon to make, but because the industry now thinks naturally and instinctively along the line of standardization. We are going to manufacture standard airplane engines, standard planes, standard military truck parts. Because they are standard, production will be accelerated, supply of material will be easier, and the government will be able to give more help if the industry needs help in getting the proper steels, etc.

Far more important, however, in shortening the war will be the amount of work in handling and maintenance which is saved by each standard. For example, two damaged airplanes can often be made into one undamaged machine, if the parts interchange. If they do not, if the engines are totally different, if the timbers are different and so on, it may be that no part of one machine can be used in repairing its neighbor. This sort of lack of standardization has been a very real handicap to the armies in France. Europe had to build up the standards it is now using from the very ground. America, already accustomed to standards, has merely to extend them a little to achieve the desired end.

It is not necessary to emphasize the very great saving in the handling of spare parts obtained by standardization. Standards cut down the number of parts that have to be kept ready, reduce the clerical work in dealing with replacements and eliminate the possibility of mistakes. Standards for war machines of any sort save time all along the line from the drafting room to the field of battle. They permit quicker advance in making attack, and more rapid concentration to meet attack.

Engineers Essential to Modern War

Without engineering standards this war could not have been fought in any way but hand to hand. The war is a war of machines, and success depends upon output of those machines. While the courage and the number of the soldiers are equally important, it is no more important than the perfection of the tools they use and the rapidity of supply of fresh tools.

In warlike standards probably the earliest were the weapons carried by the Romans, the standard sword, the standard spear. At a later stage there was the standard long bow of the English, and history records how the use of the standard length of arrow helped the archers to maintain their fire. If one man fell, a companion could use the contents of his quiver, whereas the French archers who were a mixed crowd of cross bowmen and archers did not have this advantage.

Military firearms were early standardized, and clothing, first standardized for appearance's sake, later became standardized for efficiency. It is only in the present

war, however, that there has been any effort to standardize artillery on a large scale, and mechanical transport standards are even now not in use except to a very limited extent. In passing, it may be remarked that the fame of the French "seventy-fives" was not only due to the merits of this gun; the quantities as well as the qualities counted, and still more the fact that the supply of ammunition was very large. It was a standard weapon to which everyone from maker to gunner was well accustomed.

Standardization is as old as civilization. The ten commandments are standards of conduct to guide the lives of men. From them evolve all laws. Standards of money were known in the earliest times of which we have any record, and in biblical times architects were already working to dimensional and proportional standards. The Romans had many standards of all kinds, and in later years there is no doubt that the Spanish Armada contained a number of standardized ships.

Standards Are Natural Developments

Engineering standards are only natural consequences. A standard evolves itself just as soon as there is a large enough demand and a varied enough use for a particular thing. Thus the first "dimensional" engineering standard to enter into really world-wide use was the Whitworth thread from England and the Sellers, now U. S., standard thread from America. The use of a special thread peculiar to one manufacturer is now practically extinct.

Similarly, wire gages were early standardized by wire drawers and the Birmingham mills co-operated to adopt the B.W.G. It was not a very good standard, but it served its purpose. These things were scarcely comparable with standards of *design* such as the S. A. E. has set up from time to time, such as are some of the electrical standards, such as are standard pipes and flanges used in civil engineering work.

Engineering standards divide properly into three groups. First come standards of fundamental dimension, such as screw threads, gages, tubes, bolts and screws, etc. Second are standards of assembly designs—flanges, pipe couplings, propeller mountings, bell housings, magneto mountings. Third are standards of practice, typified by regulations regarding steam boilers, rules for testing, methods of specification and so on.

Classification Line Changing

Now the dividing line between the first and second classifications is always moving. It is a battle line with the first class steadily advancing into the territory of the second. Meanwhile the second class is conquering the still unstandardized fields and is covering more ground than it is losing to the first class.

This is because things which are fundamental are constantly increasing in number. The first necessities of the automobile that became fundamental were the spark-plug standard and standard tire sizes. These standards were absolutely essential to the popularizing of the auto-

mobile. As yet there are hardly any aircraft standards which have reached the fundamental stage, but propeller mounting will soon do so if anything like the quantity of machines projected actually come to be made. In tractor work the farmer is demanding a standard height of drawbar, and it is a fundamental necessity for the implement maker as well. In time this will be as important as a standard coupling in railroad work. In general terms it may be said that any part of any machine that requires frequent replacement must eventually become a fundamental standard.

It does not follow that all the standards of the second classification will eventually come into the first class, for from the latter must be excluded all liable to change. For instance the standard generator and starting motor mountings are mainly of convenience to manufacturers. The coming of electric transmission would destroy their value. Pipes, wires, taper or spline fittings, lock washers, cotter pins and suchlike things are certain always to be used, whatever changes may come in the general scheme of an automobile; thus the standards appertaining to them must become fundamental in course of time.

The money value of standards such as the S. A. E. has set up and is setting up is incalculable. There is no means by which it can ever be reduced to exact figures because a good standard spreads too far and in checking up its advantages one is liable to be led in all kinds of directions. A carburetor maker has no method by which he could estimate the saving effected by the S. A. E. flanges. One can only see that if 20 different sorts of one size of carburetor were being made time would be consumed in the drafting in the pattern shop, in the foundry, in the machine shop, in the assembly line, in the sales and shipping department, in fact throughout the plant, in keeping track of the different batches. Taking the automobile manufacturer's viewpoint he cannot very well *price* the advantage of being able to turn from one carburetor source of supply to another without having a hiatus while the new supplier tools up for a special flange, although the money value is incontestable.

Cannot Disregard Standards

A few firms that have followed the practice of making nearly everything for themselves occasionally oppose standardization of detail design, yet you will find they employ most of the fundamental standards. No one of them is so autocratic as to use a special size of spark-plug or to have special tires made exclusively for his machine. Standards which affect parts maker and automobile manufacturer only, he can afford to neglect, but standards which affect the ultimate user he adopts invariably.

In any case, the "I can do it all alone" manufacturer is a decreasingly important factor in the work of the world, except where he has a sort of monopoly; even then in emergency he cannot expand rapidly because he cannot get help without delay. He may be able to make the very best article of its kind, that is beside the argument.

Take the case of the military trucks, now so prominent. What the army would like is just one type, identical in every detail. They cannot get it in time because no one manufacturer, and no group of manufacturers, can produce enough of a special design quick enough. But look at the troubles that are avoided by the fact that many firms have been working to standards already. Every standard part which has been in use by truck makers is readily obtainable in any quantity. Every gear manufacturer has the broaches for standard splines, every electrical firm is ready with a generator which will fit, every magneto maker can ship what he has immediately. Thus the list could be extended enormously.

If these trucks have to be obtained with the utmost rapidity the effect will be that the manufacturer of chassis who is in the habit of using the greatest number of standards will be best able to speed production. Had there been one maker who could supply the whole quota in requisite time it might have been wisest to give him the whole order, but there is no such maker. It is not in reason that there should be any more than that there should be one firm capable of building all the ships, making all the munitions or doing all of any of the special large productions of special articles called for by war.

To get ship production it is accepted that we have first to standardize the vessel. Hence long delay while the designing work is being completed, longer delay while preparation for making the parts is in progress. Every bit of standardization that has already been accomplished, that is already in commercial use, is a help in war because it cuts down that getting-ready period.

Details of Design

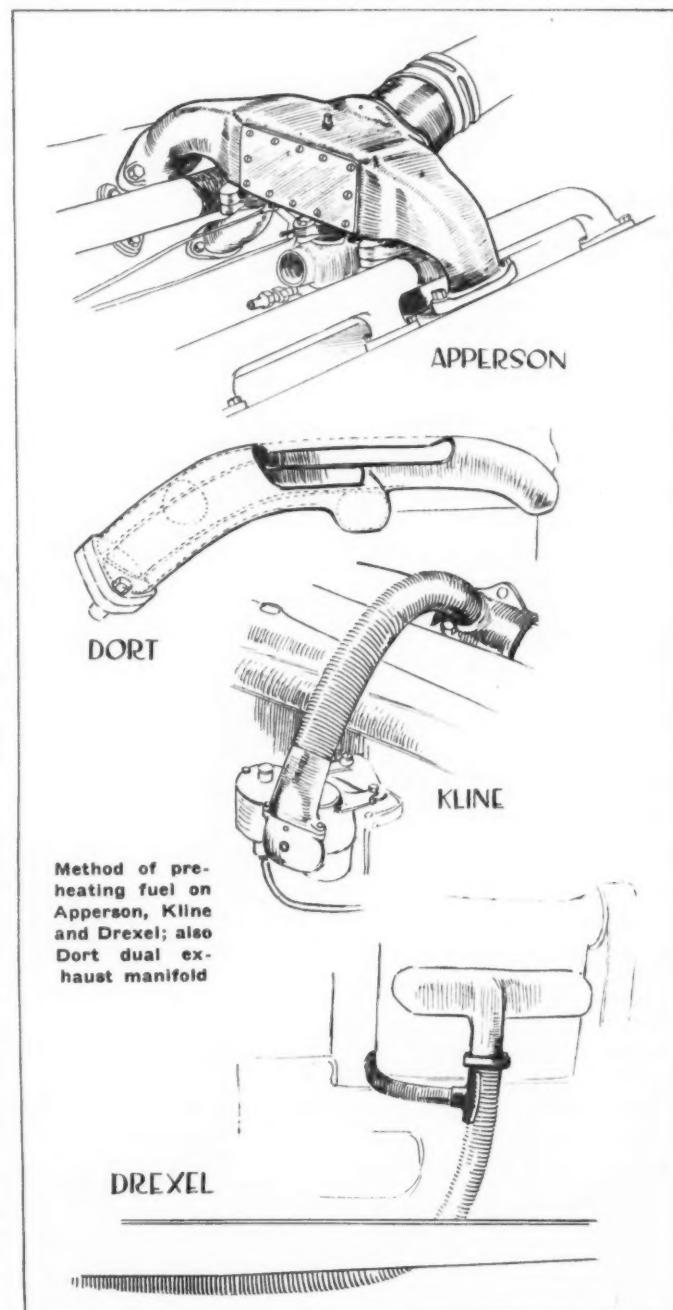
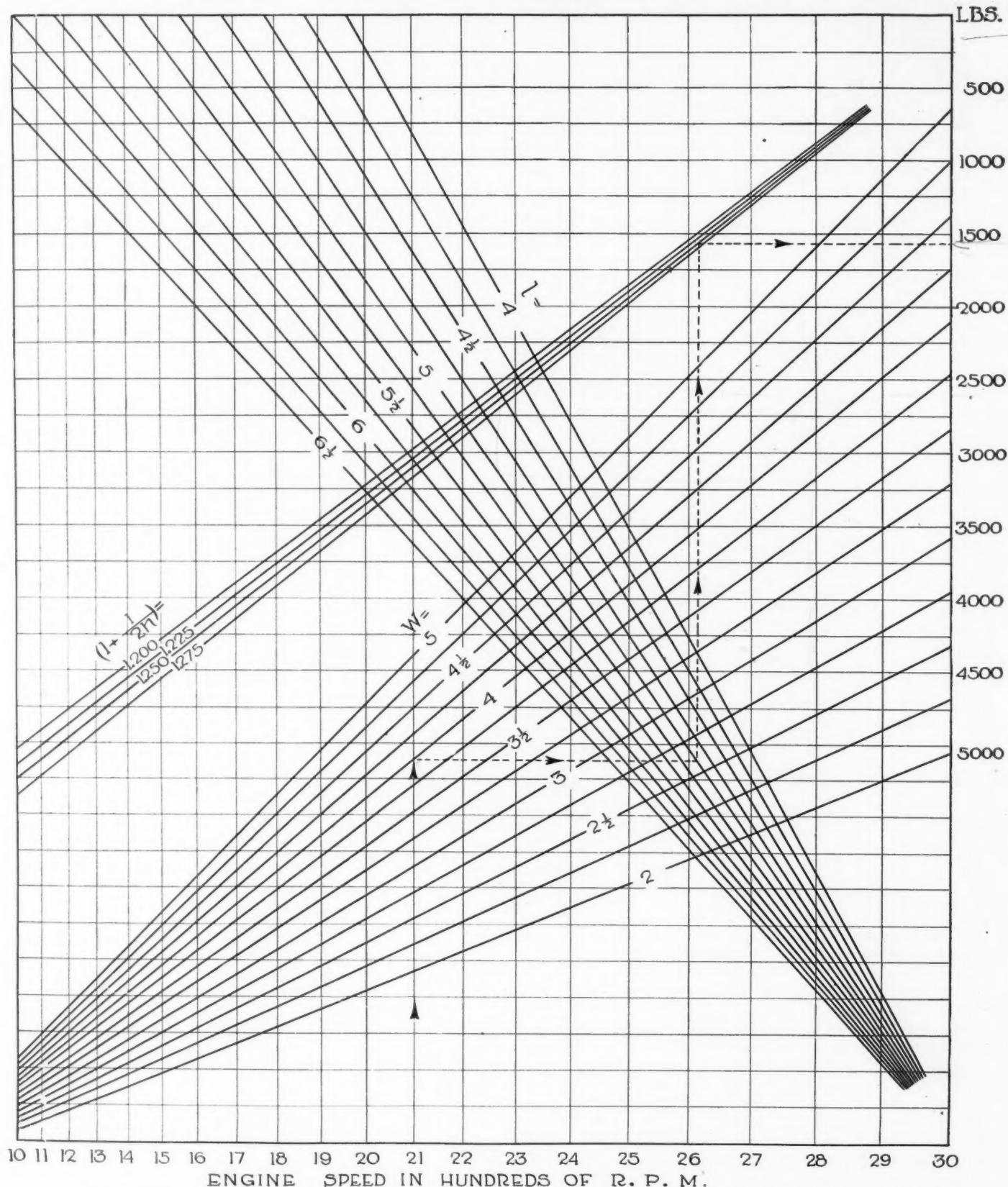


Chart for Determining Inertia Force



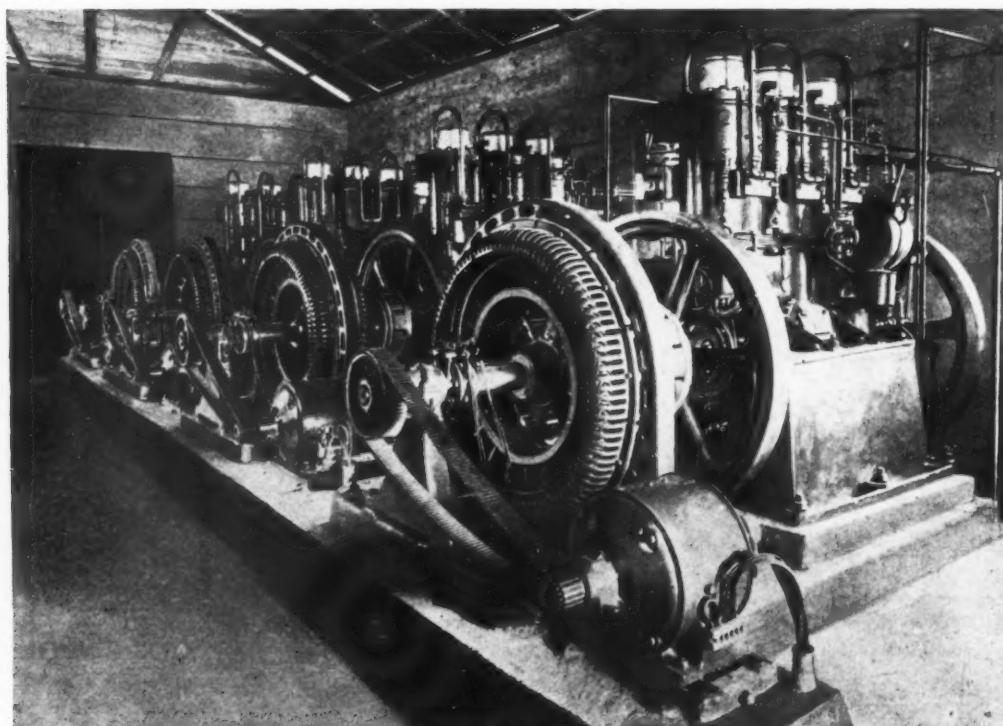
BY means of the above chart it is possible to quickly determine the maximum inertia force due to the reciprocating parts in one cylinder of an engine when the weight W (lb.) of these parts, the length of spoke L in inches, the maximum engine speed in r.p.m., and the ratio n of connecting-rod center-to-center length to stroke are known. The dotted lines with arrow heads illustrate the use of the chart. In reciprocating weights beyond the range of the chart use half the actual weight and then double the result found.

Heavy Oil Engine Facts and Fallacies

National Demand for Heavy Oil Engines Has Produced an Industrial Movement—Recklessness Brings Many Failures—Problem Far From Solved

By Reginald W. Crowly

EDITOR'S NOTE—Mr. Crowly is a recognized authority on Diesel and other heavy-oil engines in America, England, Germany and Russia. He has had exceptional experience with land and marine installations of all types of internal combustion engines.



A group of Mietz hot-bulb engines driving alternators in a Dominican power station. Each engine is of 75 b.h.p. The Mietz engine is a two-cycle type with crankcase compression of pure air, the fuel is injected after compression and is ignited by contact with a red hot bulb or hollow ball in the combustion head

IN answer to an economic law the oil-burning engine was developed abroad and not here. By the progressive operation of that law in this country, the oil-burning engine had to be introduced here. By a phenomenal operation of the same law, the oil-burning engine has boomed here. The normal operation of that law will probably hold it here. But another law, the law of unrestrained rapacity and greed, has upset the smoothness of the new industrial movement which sprang from the oil-burning engine. This phase will pass; the people will learn, and the oil-burning engine will come into its own.

Let caution be the slogan. The recklessness of ignorance and a lack of engineering imagination have scarred this new industrial movement. An oil-burning engine is not merely a gas engine with oil squirted into it.

Nor is the oil-burning engine the salvation of every man who wants cheap power. Like the gas engine escaping on wheels from the voracity of the electric Gargantua, the oil-burning engine afloat is safe from the same

grab and its biggest opportunity is afloat. But it is not established that the oil-burning engine can succeed either ashore or afloat where the gas-engine has failed, nor even that it can supplant the gas-engine in a straight fight.

The only market that has yet clearly shown its power of absorption is that of auxiliary ships. And this is where caution has most flagrantly been despised. Men have bought even engines on paper, engines never built, engines only dreamt. Almost anything that looks like an engine, or may be interpreted to look like an engine, has a market price and can be sold. Promise of rapid delivery is the only essential. And not only engine builders have made and sold rash promises, but jobbers, merchants and agents have built on these rash promises like towers on quicksand, and many an ultimate owner has a deal to rue.

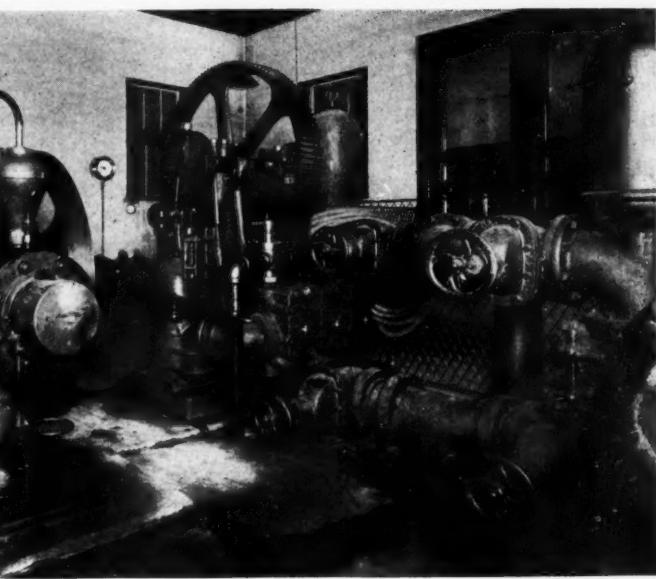
This market for auxiliary engines demands units between 120 hp. and 350 hp. Its value has run into perhaps \$15,000,000 during the last couple of years. Prices have grown up and up until they have touched \$140 per horsepower in trustworthy engines.

For the rest the market is fickle and insecure, as will appear more clearly later in this review. It has not been properly sounded; nobody has yet learned its extent; its future depends upon other factors than the oil-burning engine itself. Let us see how and why this type of engine has been developed.

Cheap gasoline directed the attention of American manufacturers to the spirit-burning engine, the easiest type to build among all liquid fuel engines. In Europe the preponderating cheapness of kerosene and other heavy petroleum derivatives influenced manufacturers to develop engines that could burn these heavier fuels. It was a development of many minds working for many years. The scale turned in this country, and the price of gasoline rose to a significant multiple of the price of other petroleum fuels. Then the demand for oil-burning engines naturally sprang up here, and it was quickened by another cause.

Five years ago in this country the makers of engines that could be claimed to burn oil did not require to be counted; there were not six. Five years ago, a number of manufacturers went into the business. Why? Because in the previous year or two there had been an increasing volume of publicity given to the oil-burning engine by the technical organs of this country, culminating in the indisputable demonstration of the success of the big engine afforded by the first oceangoing motor-ship. And that supervened upon the lapse of the Diesel engine patent claims here. The way seemed to stand open to an immediate participation in a new sphere of industry full of future promise. What was good for the big ship would be good for all craft, it seemed.

Yet European development was not ripe, and that fact was not known nor suspected here. All the efforts of many years in the different countries of Europe had merely brought the oil-burning engine to the verge of real development. European manufacturers were then passing through the maze in which the American manufacturers have spent the last 5 years. It was still to be demonstrated beyond all cavil that many Diesel engines were doomed to failure from the outset, that others could be made successful only after long trial. It was still to be shown that the simpler-looking hot bulb engine, mis-



Mietz pumping plant at Westhampton, L. I.

named a semi-Diesel engine, held problems enough to baffle mediocre efforts. Only the advent of the war hid German engineers from the full exposure of the most amazing series of engineering blunders that the whole industry has known. Only the lack of a larger market saved the English engineers from exposing their blunders on a smaller scale in the hot bulb engine domain.

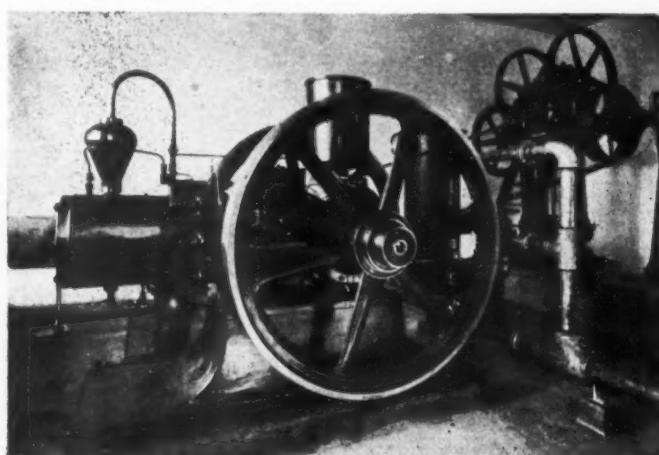
Now Restored to Favor

Is it a matter for wonder that American engineers advancing all unsuspectingly into this field were also beaten at the start? Is it surprising that the failures of American submarine engines became a byword in the world? Is it difficult to understand why the Diesel type engine first and then the hot-bulb engine were marked down here as failures and were resting under that curse until the blithe pioneers of the Pacific Coast rescued them and by an amazing turn of luck restored them to a favor from which they are again falling?

Let it be clearly expressed, to prevent misunderstanding, that there has not yet been in this country any construction of any account in engines over 500 hp. That was the limit which the marine gas-engine reached; that is the limit of development we are considering in this country.

In Europe the advent of the Diesel-type engine about 20 years ago set a standard of performance by which the manufacturers of oil-burning engines gradually learned to judge their accomplishments. The Diesel-type engine, with its consumption of half-a-pound of oil per b.h.p. hour, came into a world which knew only engines that consumed a pound of oil per b.h.p. hour. The saving to be effected by the Diesel-type engine was therefore very pronounced. It is important to appreciate this point, because there is justification for making the statement that if the Diesel-type engine had remained to be invented to-day and if other oil-engines nevertheless had been developed as they are to-day, then the Diesel-type engine would be an insignificant unit in the market and would scarcely have been heard of.

There is no need to recapitulate why the Diesel engine proved such a benefit in Germany; no other oil-engine could have been so beneficial. In no other country, however, did this engine find such favor, although in Russia it made good progress, for reasons that do not concern this article. It did on the other hand influence oil-engine development in other countries, and the aim of manufac-



A typical pumping plant Mietz heavy oil engine



Above—Two 350-hp. Bolinders engines in the municipal power station, Perth Amboy, N. J. Left—A typical sailing vessel with auxiliary oil power, the schooner Mabel Brown. The engines consist of two 160-hp. Bolinders units

ture became not merely the reduction of fuel-consumption to the Diesel standard, but also the attainment of the same apparent indifference to fuel quality as the Diesel-type engine showed.

Naturally, this influence did not spread noticeably until the Diesel engine had entrenched itself firmly in the engineering world, say 2 years after its public appearance, or, in other words, 10 years ago. By one improvement and another, from many hands, there did ultimately come engines that were not Diesel-type engines but which could show a variance of less than 10 per cent from the Diesel standard. This awakened fresh efforts, to which we now owe the whole range of the superior type of hot bulb engine that has a fuel consumption not more than 20 per cent above the Diesel standard, without a shadow of its apparent complexity.

A Type for General Purposes

And this is a type of engine very well suited to the general demand of the world, and particularly well suited to the demand in this country. It is very simple, but not yet foolproof. It can be built in any modern shop, with due regard to its particular exactions of workmanship. It can be operated by the ordinary type of engine operator and even by a moderately intelligent man who has substantially no knowledge of engines, but it cannot be operated by a fool. It can be built at a price enabling it to be sold without too much difficulty and giving it the opportunity of a fairly large market. It can burn kerosene, gas-oil or a really light fuel oil—not heavier than say 30 deg. Baumé. And when not fooled with nor abused it is a reliable engine. That is the type at its best.

The Diesel-type engine per contra cannot be built within less than \$20 per horsepower above the price of the hot-bulb engine of equal material and workmanship, other conditions being equal. It can be operated only by intelligent engine operators. It is in fact a splendid theoretical engine but does not suit the prevailing condition of labor in this country.

Now when one digs at the root of engine buying and selling it becomes clear that within the limits of horsepower contemplated by this article the prime factor is low first cost. Fuel is cheap. The less one uses of it, the less its price matters. Good labor is not merely expensive, but difficult to obtain. Weighing these considerations one can see that fuel economy can be neglected

in small engines and the necessity for good labor is to be avoided if possible; hence the cheapest engine will sell sometimes quite irrespective even of whether it will operate. For larger engines the fuel cost exerts more influence, but it cannot commence to be predominant unless there can be question of saving so much on the fuel bill as will extinguish the effects of other greater outlays of money that accompany its attainment. Even then a higher consideration generally intervenes.

There are, namely, instances where engines below 500 hp. are purchased by individuals or corporations having such superfluous financial resources as will permit them to increase the initial outlay for the benefit of a small annual economy. In by far the greater number of cases the engine is bought by a party desirous of spending the least capital that will provide the power required, and most often the money available determines the power of the engine to be bought.

The limit of these practical considerations cannot be shown more clearly than in the words of a man who felt the limit and was able to express it very clearly. He wanted an oil engine and had so informed an oil engine manufacturer. The prospect seemed to call for a salesman, and one was promptly sent out, who quoted the regular price and countered its effect by pointing out how little the engine would cost to run. "If it ran on nothing at all, I couldn't afford to buy it at that price," was the rejoinder, and perfectly true it proved to be.

First Cost Counts Most

Exceptions there will always be, but in the great majority of cases, the first cost counts the most. That should put the Diesel-type engine out of the running, and so it does. Now, I know of Diesel-type engines of small power and of moderate power that persuasive salesmen, deferred payments, exaggerated promises of performance or other influences have succeeded in selling, a mere handful. A few more may go the same way, but without entering into the details of such cases as I know, I can assert that practical experience has confirmed the opinion here laid down that the expensive Diesel engine in small or moderate powers cannot make headway against the cheaper hot-bulb engines.

For yachts and submarines there are particular advantages of the Diesel-type engine that outweigh the consideration of cost. A man on pleasure bent or a govern-

ment spending the taxpayer's money does not count cost in the way most people have to count it under ordinary circumstances. The Diesel-type engine has a restricted future for such craft and similar craft, but it will not survive for other purposes. In this connection, however, it may be stated that a few Diesel-type engines have been sold for auxiliary installations with the only recommendation that they could be delivered earlier than hot-bulb engines and enable the ships to be completed earlier.

And as for sea, so for land. All that the Diesel-type engine can do can nowadays be done more cheaply by the hot-bulb engine, so far as this country is concerned. Where fuel is expensive a different conclusion may be reached. Not so very long ago the Diesel engine was supreme as an oil engine above 300 hp.; now it is no longer alone in that field. The hot-bulb engine has climbed to 500 hp. and over with success.

But here is the rub. Hot-bulb engines are of many different grades. Some are good, some are bad, some are modern, some are old, some even are hot-bulb engines only by virtue of the name given to them by their manufacturers. How can one distinguish between them?

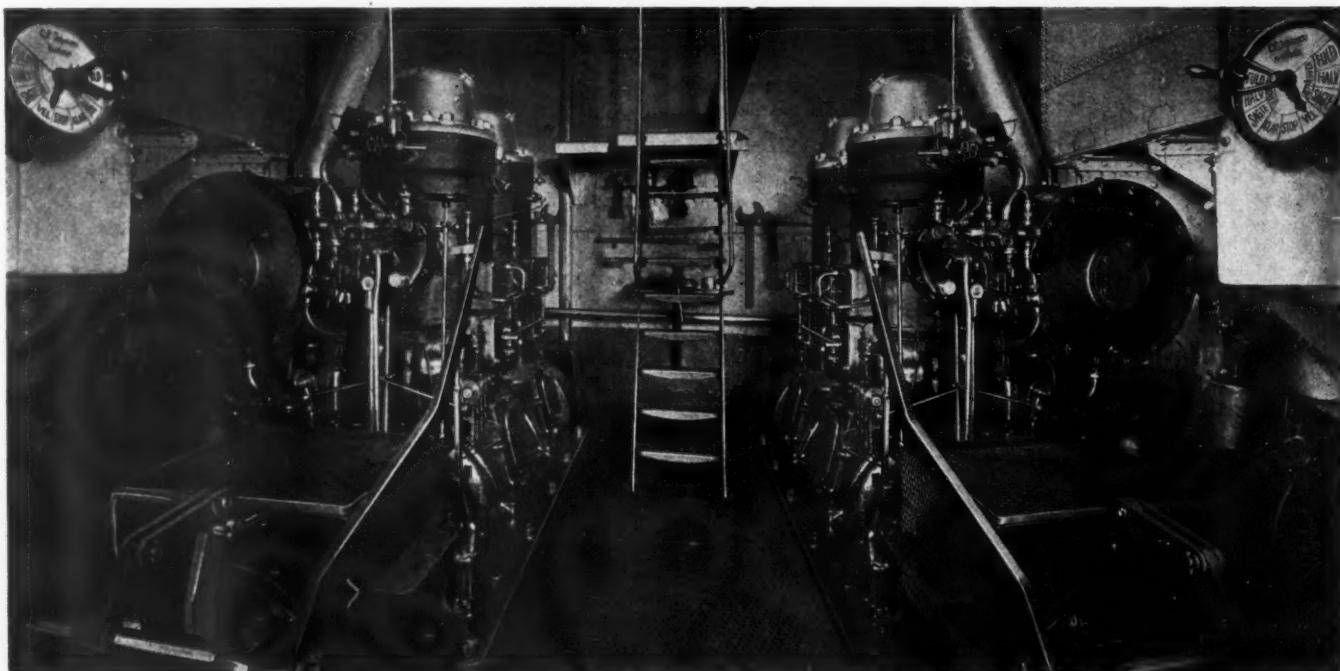
Well, experience alone can sort them all out. But judgment, careful and cautious, and, of course, a little experience, can weed out a goodly number of the poor ones. Some general observations also can be made for useful guidance. In the first place, always mistrust—this is not synonymous with "condemn"—a new design, for in no branch of internal combustion engineering can one follow the book so little, or is one required so much to be directed by experiment as in the building of hot-bulb engines. In the second place, do not credit a new engine with assured success merely because it is the copy of a well tried and well proved engine. Thirdly, do not pass over an engine of small reputation merely because it is the product of a small shop—it may be the fruit of several years' clever labor by a man of poor business ability. In sum, these three observations have a common source, viz., that it is experience which counts and the reason therefor can be told.

In the hot-bulb engine a fuel is used which is not volatile at any natural atmospheric temperature, which is not easily forced into admixture with air in a combustible form and which readily reverts from an atomized

condition into the condensed form. The ignition depends upon a combination of the temperature due to compression and the temperature superadded by the interior surface of the hot bulb. How will you design the bulb to attain the object in view? How will you meet the conditions of varying loads? Let us see a few of the disturbing factors that may arise, and then we shall know why so many manufacturers have failed to turn out a dependable hot-bulb engine.

No Difficulty with Ignition

It may be premised that in respect of ignition the Diesel-type engine presents no difficulties, because the ignition is governed wholly by the heat of the compression, and so long as the oil does not enter in a stream so surely will firing take place. The troubles with Diesel engines are not of this order. With the hot-bulb engine, at an assumed constant load, all will be well if the combination of the pump pressure and the spray nozzle cause the fuel to be so broken up that the heat of the combustion chamber and of all or part of its surface will produce and maintain an inflammation enabling the fuel to completely burn in the turbulent mixture which by some manner or means must be produced. If the spraying is not sufficiently fine to enable the minute particles of oil to burn completely during the short stroke of the piston then there will be sootting. If the turbulence is not great enough to permit each minute particle of fuel to have air sufficient for combustion then there will be sootting. Remember that the mixture can in this type of engine—to avoid pre-ignition—not be made until just prior to top dead center, and whether it can be made either wholly or partly prior thereto depends upon the bulb, upon the combustion chamber as a whole, upon the temperature in both, upon the rate of mixture between fuel and air, upon the degree of fineness of subdivision of the fuel produced by the injection, and upon the nature of the fuel itself. To continue again the possibilities of trouble, if the heat of the bulb be insufficient, then either ignition will be late and there will be sootting, or ignition will fail. Any sootting will finally arrest the operation of the engine because according to the nature of its cause it will either choke the injection, prevent the mixture forming or produce pre-ignitions.



Bolinders engines, each of 120 hp., in engine room of schooner Elfreda, a 1900-ton vessel which has been in service all over the world



The largest motor ship built in America—4500 tons. Owned by the Standard Oil Co., this vessel has three Bolinders engines, each of 500 hp. These engines are direct reversible

Then when the balance of all factors has been found at one load the balance is far from having been found at all loads. The load variations mean temperature variation, and that varies ignition. When water injection or water drip was in fashion the control of the temperature within the combustion chamber was easy, but buyers did not want to be bothered with the water regulation or with any water at all inside the cylinder, and that has had to be relegated to the limbo of hateful devices. Other means have had to be devised—and, sad to relate, because these other means have not been properly devised on many engines so do many engines fail in practice.

It is useful to remember that in the early Hornsby-Akroyd, the prototype of the modern hot-bulb engine, the mixture was formed during the suction stroke of the four-stroke cycle on which that engine operated, and the firing was quite dependable on all loads except the very lowest and except on very heavy loads or overloads, when thumping used to warn of pre-ignition. The same thing can be done to-day with a two-cycle hot-bulb engine if one will sacrifice fuel economy, because kerosene alone is suitable for that process of combustion and because one cannot get below $\frac{3}{4}$ lb. of fuel per brake horsepower hour with it. Actually, there are engines on the market which are so far comparable with the old Hornsby-Akroyd system that they maintain the old rate of fuel consumption even though they spray the fuel just before firing. They are not to be counted with the modern engines, although their manufacturers succeed largely in classing them as such.

In general, it may be stated that the manufacturers here have not succeeded in producing really satisfactory hot-bulb engines. Even an old firm or two which have made many small engines have not achieved in the large engine what can be called success. They have failed to appreciate the problems they have faced—they have depreciated their task.

It is not surprising that the upstart firms and small shops have failed, but it does awaken wonder that firms associated with the very largest corporations in the country have followed the same way. On every hand the difficulties of the problems seem to have been woefully scorned. There is clear circumstantial evidence that many have thought a hot bulb and a fuel pump of practically any shape, form or design would perform the service. Particularly on the Pacific Coast, where boundless confidence always rules, does this thought seem to prevail, but the Middle West and the East have been infected in the same way.

Perhaps I am too exacting. My standard is the best. Evidently, however, it is not too high a standard, because one American firm has my full confidence—I exclude imported engines, although as a matter of fact only one

of the imported engines is worthy of full rank. Yet even if my standard be deemed too exacting, then at least I can wipe out whole rows of engines as being rankly unsatisfactory, leaving only a few passable ones.

The great need to-day is for more trustworthy hot-bulb engines. The great need for the future is that those engines shall be cheaper. The sudden demand for this type of engine in imitation of the successful imported ones that started the stampede has attracted into the business scarcely any firms of good credit and standing and it has been responsible for still fewer good engines. The conditions repeat a story that has often been told, the old story of a boom in which a few make money quickly before the bottom drops out and are followed by the hard workers who are satisfied with normal profits.

There is to-day a big significance in the multitude of new devices that are being added to the hot-bulb engines by various manufacturers and in the numerous variations being made in this type of engine. I do not pass judgment on the actual practical merit of these changes, because they are yet too new. Some of the engines that are appearing are no longer hot-bulb engines, nor really can they be covered by the broader classification of "surface ignition" engines. The bulbs have made way before rods, tubes, spoons, piston caps and such forms of highly heated devices within the combustion chamber. In other designs again the use of electricity has been called into play, sometimes for merely heating the ignition surface, sometimes for ignition by direct spark. This promises progress. The great criticism against the hot-bulb engine to-day is the bother of its blow torch.

Making Engine Automatic

More, much more, must be done to make the engine automatic. Its apparent simplicity is an evil; it deceives. The very best of the hot-bulb engines are to-day in many instances giving trouble on this account. The operators think they can go to sleep and not watch the engine. This is literally meant—such cases are occurring with sad frequency. Particularly is improvement needed in the lubrication systems. A two-cycle engine is always more difficult to lubricate than a four-cycle engine, and since most hot-bulb engines are of the two-cycle type their susceptibility to lubrication trouble is increased. Burning out the bearing is no uncommon failure, not that the bearings cannot be lubricated properly, but because the prevailing practices require the lubrication to be watched and the men do not watch.

Another plentiful cause of erratic behavior in even the very good engines is the widespread claim that any fuel can be burned. It is indeed true that these good engines will for a time consume any sort of vile fuel, and in the hands of the skilled operators in the factory they can be made to run for very long periods on a dirty unsuitable fuel. In independent service, however, the engines soon balk at this. Actually, some manufacturers seem thoroughly convinced that any fuel is suitable. They mislead themselves by shop results, and however capable they may be in other respects, they betray a woeful lack of understanding in this regard. They never see their engines in outside service, and regard all reported troubles as arising from the employment of fool operators. They cannot appreciate that most of the engine operators on small engines are virtually fools—they ought to provide against that.

Especially in marine work is it difficult to get good men. The good men make more money ashore. Such a problem has this become that one finds ordinary chauffeurs being persuaded to go to engine works to learn to take charge of the engines their employers are buying. They do not learn much in the first place, and secondly, a

couple of voyages generally finds them permanently ashore again. Then the position has to be filled by one of the least satisfactory of all men—the cheap marine engineer, for obviously one cannot pay high wages to have a small engine looked after, although frequently it looks as if that course would be cheaper.

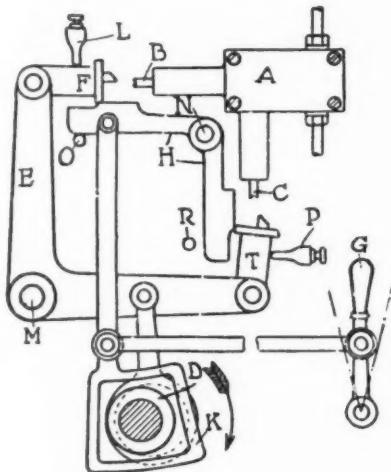
And when one seeks the inspiration of this remarkable expansion of an industry that even about 2 years ago was still in its infancy and is now in a boisterous and over-exuberant youth, one finds a cause which has now pretty generally come to be regarded as a signal for caution. The war has caused it. Not until the shipping world realized that the stoppage of English and German shipyards from the regular production of mercantile tonnage would soon cause a shortage, not until after the steel shipbuilding yards of this country were choked with orders, did the influence of the Pacific Coast make itself felt. Natural causes had been responsible for the development there of a unique type of boat, the steam schooner of the lumber trade. Oil engine competition

had, just about the time of the outbreak of the war, prepared the way for the first oil-engined schooner of that type. The advantages of the new style were avidly recognized by those people who regard oil as others regard coal, and who are always for something new. When therefore the previously dwindling wooden shipbuilding industry became awakened to the fact that it was to have a new lease of life because wooden ships would everywhere be deemed better than none at all, the oil-engined schooner was adopted as a type that might enable the wooden vessel to compete afresh with the steel ship when normal times should return.

That started the stampede. Oil-burning engines were not really a market product then. To-day they are. And the call of the Pacific Coast for oil engines has stimulated the same call all over the country. The New England fishing industry, conservative in the extreme, is falling into line with the demands of the new shipbuilding industries, now spread to the South, and now also crowding the

(Continued on page 1236)

Bolinders Two-Cycle Reversible Engine System



THE Bolinders engine is reversed by changing its direction of rotation. This is done by slowing it down and then preigniting a charge so as to stop the rotation and start it again the other way around. The detail of this operation is shown in the diagram.

A is an oil fuel pump having two pistons *B* and *C*. *B* is adapted to work when the engine is running in one direction or another, while the other *C* is used for reversing. An eccentric on the main shaft rocks to the lever *E*, which is moving round the bolt *M*. To this lever two strikers *F* and *T* are attached, which, operating the two pistons *B* and *C*, slide on two faces on the angle-piece *H*. This angle-piece has a motion round the bolt *N*, the extent of which is determined by the abutments *O* and *R*.

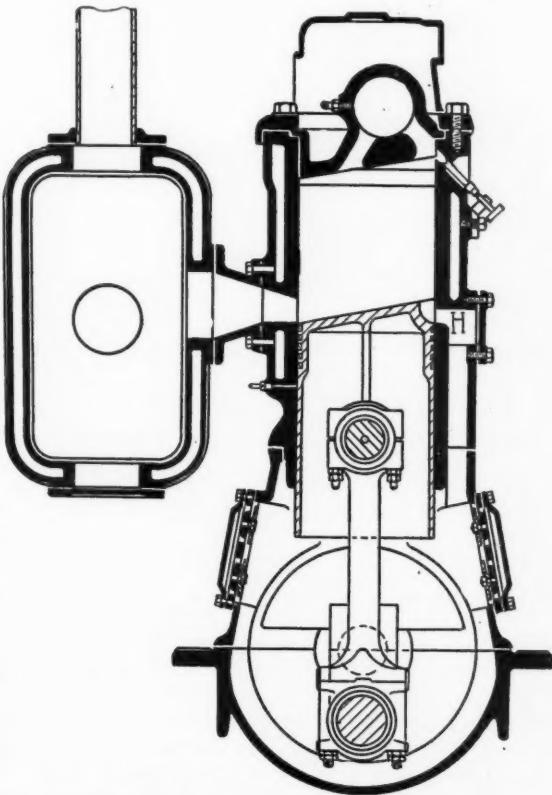
At *L* and *P* there is one spring to control the speed and the amount of fuel supplied to the cylinder. The link *K* surrounding the disk *D* is connected by a rod with the angle-piece *H*, which latter can be lifted from the abutment *O* and at the same time moved toward the abutment *R*, thus engaging the inside vertical edge of the link *K* with the friction disk *D* by means of the reversing lever *G*.

Suppose the engine to be running ahead in the direction of the arrow, *H* is then pressed against *O* on account of its own weight and also by the weight of the link *K*. The striker *T* is thereby raised so that it cannot strike the piston *C*, while the striker *F* working during normal running for ahead or astern, takes up such a position as to be able to strike the pump piston *B*. The reversal of the direction of movement of the engine takes place in the following manner:

The reversing lever *G* is thrown to the right, so that the edge of the link *K* is brought into engagement with the friction disk *D*, which is thereby lifted. The horizontal part of *H* is thus lifted from *O*, thereby raising *F* so that it cannot strike the piston *B*. The engine will in such manner, owing to this and to the spring *P*, slow down automatically to a speed suitable for reversing. While the horizontal part of angle-piece *H* was lifted as above, the vertical part of same

angle-piece *H* is moved from the position illustrated toward the abutment *R*, giving the striker *T* the position in which it will press the piston *C* inwardly and consequently feeding one charge of fuel into the cylinder. This will explode before the working piston has reached its innermost position. The piston is thus stopped, driven backward, and the engine begins to move in the opposite direction.

Immediately the engine has begun to rotate in the opposite direction the link *K* is moved downward due to the friction created by the disk *D*. On account of this the horizontal part of *H* is automatically shifted toward the abutment *O*, so that the striker *F* is again made operative and the striker *T* is thrown out of action.



SECTION of Bolinders engine drawn to show system. The hot "bulb" is seen in the top of the cylinder, and just beneath it, on the right, is the fuel injection pump. The port on the left is for exhaust and the port on the right admits compressed air from the crankcase. The exhaust opens first, letting out the first rush of discharge, then the air enters and is compressed; finally injection and ignition by the heated bulb occur just at the top of the piston stroke.

Two Million Tractors Wanted

U. S. Government Should Standardize Design and Control Production

By A. Ludlow Clayden

AMERICA could produce enormously greater supplies of foodstuffs than she is doing at present if greatly increased areas could be cultivated. To the rapid expansion of agriculture there is only one restraint—the shortage of labor. The productive power of labor depends upon the mechanical assistance available. The farm tractor is doing for agriculture almost as much as the steam engine did for manufacture. Power, hitherto, has been applied to farming in only a sporadic way. The day has come when agriculture must be lifted to the same plane as mechanical industry.

IT is the farmers of the Americas and the farmers of the British Empire that are going to win this war. Industry stands back of the farmers; it cannot give them many men, but it can give them machines, and one machine is the equivalent of many men. The acreage that now is cultivated per head of farm labor can be doubled, quadrupled, multiplied a score of times, perhaps, by the tractor and the machines the tractor operates.

England, to cultivate an extra 3,000,000 acres in a year, needs 20,000 tractors. If England needs this quantity, what must be the need of the Americas and of the rest of the world?

The British government will build, is now building, 10,000 tractors, and will itself attend to the cultivation of 2,000,000 acres of new land. The other new 1,000,000 and the maintenance of the existing farms are left to the farmers themselves, who are expected to buy where they can the second 10,000 tractors.

United States Only Source of Supply

At present, the only source of supply of tractors is the United States, and the United States must supply the world. Of the output this coming year, England wants 10,000. France will want at least as many, Russia a great quantity, Australia, New Zealand, Canada, South Africa, the Argentine, Brazil, Italy, Spain, Portugal, and many other countries are calling for many thousands, and this is the export market only.

If England can find 3,000,000 acres, what can the United States find? What can be found in the rest of the world? There must be 300,000,000 acres ready and waiting for the tractor to convert them from waste land to fruitful farms. There must be a field for 2,000,000 tractors, and an immediate field at that.

America cannot build 2,000,000 tractors in a year, nor in five years, but twice as many could be produced by proper organization as will be produced if the matter is left to individual factories operating in a normal busi-

ness way. Our business is war; war is different; business must be different.

Suppose the government of the United States chose a standard design for a tractor. Suppose they called for bids on parts for 1,000,000. Suppose they arranged with some of the big automobile plants to handle the assembly. Suppose they arranged for the sale of the tractors at home and abroad. How long would it take to produce that million machines?

Overthrow Tradition

Of course, such suppositions assume the complete upset of tradition. Immediately enormous political difficulties become evident. But this is no day for traditions. The world wants those tractors, must have them, in fact, and it is a duty to civilization and democracy to produce them by whatever means we can. It is a duty to make them, a duty to buy them, a duty to use them to the limit. No scheme to-day is too big, nothing too new, nothing too opposed to the ancient order of things to be successful. A man saving himself from sudden death shows a strength he never had before. That self-same strength is latent in a nation even more than in a man; it can achieve the apparently impossible when forced to do so.

What would the application of such a scheme do to the tractor industry? There is only one answer: it would advance that industry twenty years in one year. It would take it, young and striving, and leave it full grown; leave it one of the great industries of the world, ready to take at once the place it must occupy eventually. Once grant that the political difficulties can be surmounted—and they can be easily—and the mechanical difficulties are small. Among the tractors we have there are enough good designs; there is no need for more experimental work, no need for much expenditure of time in preparation. The mechanical task is properly to allot the parts, to give out the work to the existing

tractor industry and to other industries in proportion to the manufacturing ability of each.

There is need for more than one size of tractor, probably for more than one type, and it would be easier to make several designs than one only. A two, a four, and a ten-plow are suggested for size—probably 300,000 of the first, 500,000 of the second, and 200,000 of the largest size. For each size there might conveniently be two or three designs, partly because of difference in the conditions of working in different places and partly to facilitate manufacture. The idea that variation in design could help production seems rather extraordinary, but above a certain quantity absolute standardization would have to give way to facilities for making particular pieces.

For example, the easiest and probably the most satisfactory way to get engines rapidly would be to accept two or three existing designs for the production of which factories are already tooled up. Suppose, just for argument's sake, that Continental, Waukesha, Buda, and similar engines were all approved, it would be easier to speed up the output of each than to have all the different factories working on one engine. The engines, as complete units, could be made interchangeable in the chassis far more easily than they could be made interchangeable piece by piece. The importance of getting a quick start is so immense.

In transmissions, a closer standardization could be followed, since the amount of tool equipment at present

Suggested Specification for Standard Tractor

Engine

Four cylinder vertical minimum 16 b.h.p. at flywheel when running on kerosene or its equivalent. Maximum power developed at 1200 r.p.m. to 1500 r.p.m. Poppet valves. Detachable cylinder head. Three-bearing crankshaft. Minimum size specified for bearings. Maximum weight specified. Crankcase arms or supports of standard spread to fit standard frame or bed. Standard length from flywheel to cooling fan. Standard positions for cooling fan and ends of water pipes relative to flywheel (to suit standard radiator and position thereof). Magneto ignition. Standard carburetor and air filter to be mounted on engine. Overall height and width to be within fixed dimensions. Height of carburetor relative to crankshaft center not to exceed fixed dimension (to permit same head for gravity fuel feed from standard tank location). Splash or pressure lubrication maintained by pump. Standard oil-cooling device. Minimum oil capacity of crankcase. Minimum water capacity of cylinder jacket. Minimum thickness of cylinder walls (to permit reboring and fitting of oversize pistons). Minimum length of connecting rod.

Clutch

Cone in flywheel. Connection from flywheel to transmission by universally jointed shaft of standard length and standard detail dimensions. Throw-out mechanism for clutch to be mounted on shaft attached to crankcase (making engine and clutch one unit).

Transmission

Two speed. Entirely separate from engine. Rear end of case arranged with standard bolt circle for attachment to housing of jackshaft or rear axle. Standard taper on rear end of gear driveshaft for bevel pinion. Gear ratios giving 1½ and 2½ m.p.h. at specified engine revolutions. Sliding gear shift. Dimensions of gears and shafts standard for absolute interchangeability. Roller or ball bearings throughout transmission. Indirect drive on both speeds. Front end arranged for support on or suspension from a swivel joint.

Jackshaft

In pressed-steel housing. Differential and bevel drive mounted in casting attached to rear end of transmission. Pressed-steel housing carrying roller bearings at outer ends for jackshafts. Sliding couplings to connect jackshafts with differential to permit ready removal of latter and allow a little

universal motion so that small error in alignment is of no importance. This would facilitate roller-bearing renewal also. All shafts and gearing standard size. Housing fitted with frame attachments like spring tables of standard dimensions.

Rear Axle

I-beam forging, of specified minimum dimensions. Renewable bushes at either end. Standard size roller bearings for wheels, rollers running on renewable bushing on axle and corresponding bushing in hub. Brackets for attaching rear axle to frame of specified design so that distance between center of jackshaft and center of rear axle can be varied to allow for gear-ratio variation and wheel-size variation.

Final Drive

Pinions on jackshafts and bull ring on wheel. Series of dimensions to give different ratios, etc. Exhaust from engine divided and pipes led to blow exhaust against the jackshaft pinions. Jackshaft pinion of such design that removal is easy without disturbing any other part.

Rear Wheels

Standard interior dimensions for hubs and standard bull gear. Several diameters.

Front Wheels

Standard hub dimensions. Several diameters.

Frame

Steel of recognized structural form. All frame members straight, so as to require no bending. Minimum number of pieces.

Front Axle

Mounted on transverse spring, with central pivot attachment to front end of frame. Standards for spring attachments on frame and axle.

Radiator

Cast tanks and gilled tube. Mounted in front of engine. Absolutely standard mounting dimensions. Minimum radiating surface and water capacity specified.

Steering

Hand wheel, and chain connection to front axle.

Control

Pedal-operated clutch and conventional gearshift.

Drawbar

Standard height from ground and standard attachment to frame.

concentrated upon any one type for tractor use is small. The same applies to the axles and to the wheels; in fact, it is mainly in the engines that the advantage of using several designs seems greatest.

Convertible to Creeper

The chassis should be such that creeper equipment could be applied instead of wheels without any structural alterations to engine or transmission, for the track-layer is the better machine for many purposes. Also for ease in assembly and in replacement of any part the tractor should not be too tightly tied into one piece. The engine should be one unit with the clutch. The transmission should be separate, connected to the engine by nothing more than a shaft and coupling. The rear axle should not be so intimately connected to the transmission as to call for the tearing down of both for the replacement of a part in either. Weight should be studied, and reduced to the limit, because weight means steel, and steel is the limiting factor in production. The less the weight the greater the number that can be built.

It will be seen that these sketchy specifications are opposed to the design of the machine which the British government is building, the Ford that is, and it is the writer's idea that the Ford production would be best left out of consideration in the scheme so far as manufacture is concerned. The *distribution* of the Ford might have to be pooled with that of the other machines. The reason for this opinion is not any lack of appreciation of the Ford tractor, which there is every reason to believe is one of the best yet constructed, but merely because it should be easier to make a less "unified" tractor after the fashion suggested than to concentrate other factories on production of the Ford design. With its vast resources, the Ford factory could produce complete Ford tractors with probably more efficiency than it could make parts for assembly in the government machines. The Ford output might conceivably be such that it would not be necessary to make any other tractor of precisely the same pulling power.

Ford Company's Position

This, however, is a matter that cannot be decided without close investigation of manufacturing facilities. Ford's ability for production makes it impossible to include the Ford factory in any general consideration of the industry, so far as tractors of the same size are concerned. When we turn to larger or smaller machines the existence of the Ford makes little difference to the problem as a whole.

Of course, if such a scheme were adopted, the writing of the specifications, the choice of the design in all its details, would have to be decided by a committee of men whose opinions are entitled to respect, but they would probably not differ greatly in general terms from the specifications on the opposite page.

These are main points only, but the specification outlined appears to be about the simplest that can give real satisfaction in the present stage of the art of tractor design. Of course, much of it is debatable. It represents one man's ideas, and no doubt could be much improved upon. The main thought, however, is ease of production. For example, there is no doubt that the truck type front axle makes a better job, but it costs more, and has more parts. The exposed clutch and universal connection to the transmission has drawbacks, but the reason for suggesting them has already been defined.

It will be noticed that details of the engine are not too tightly fixed. The wheel construction is left open, and so on. It is assumed that the engine would be inclosed completely, the clutch might be inclosed with it. A good

idea would be to provide means for heating the carburetor by a blow torch, so as to enable starting on kerosene, but as long as the engine gave the required power on this fuel there should be no necessity for limiting the means of carburetion. We do not yet know whether normal compression with water or low compression without water is going to be the best solution of the heavy-fuel problem. It would be advisable to utilize several carbureting systems at first, both for facilitating manufacture and for the opportunity offered for gaining knowledge on a large scale. In this connection the use of the detachable cylinder head has the advantage that alterations in compression are possible with very little interference with production.

Should Use Patents

It will be noticed that specifying the direction of the exhaust upon the bull gear assumes acquisition of certain patent rights. Patents of so excellent a quality should be used. Because something is patented should be no reason against it. To bar out patents is to put a restraint on inventive genius, and with the power of the government behind the scheme no inventor could oppose the use of his patent. If not presented to the government, as it probably would be in most cases, the government has the power to appraise and buy at its own valuation.

The wheelbase, the width and the size of the wheels are matters for discussion. They are unimportant in any case except in so far as they affect the gear ratios.

For conversion to a creeper type, such a machine as the one outlined would not require much change. The jackshaft and transmission might be moved back, or the frame shortened; the whole machine would be lowered, and the creeper units attached to either side, after the fashion of the Cleveland tractor. On each end of the jackshaft there would be pinions driving a small internal gear on the rear wheels, outside of which the brake bands for steering could be arranged. The same cross spring and pivotal attachment to the frame could be used in front.

With the next larger machine, the four-plow outfit, the specifications could be almost the same, unless, perhaps, a higher speed was desired. Two speeds should still be enough. The engine would need 25 to 30 hp. at least, and the revolutions might be cut down a hundred or two. Were it not for the importance of saving weight —because weight means material and so cost—it should be possible to use many identical parts, but under the circumstances the control details and the steering gear appear to be about the only pieces which would not have to be larger. It is also quite debatable whether the advantage of the automobile-type front axle does not entitle it to be employed on the larger machine.

Biggest Tractors Least Satisfactory

The biggest tractor is a more serious undertaking. On the whole, the biggest machines are the least satisfactory. There are few large engines of really modern design. At least 60 b.h.p. is necessary, and this makes a very large four-cylinder unit when operation on heavy fuel is a requisite. Further, the transmission, if made precisely on the lines of the smaller designs, becomes correspondingly large. There is a great deal to be said in favor of an eight-cylinder engine, using the same dimensions as the larger of the other two rather than a large four. There is even possibility for argument in support of the use of two independent engines, boat fashion, but it is out of place to consider such developments in an article of this nature. Probably the big machine could and should be left out of consideration

until the scheme for producing the smaller ones was in smooth operation.

The great thing is that those two million tractors have got to be built. The steps by which they can be produced in minimum time are: First, the creation of a government department to handle the business end of the matter. Such a department should be free from politicians, and should have for its personnel such men as are now going into the aviation department—the Henry Southers and the Howard Marmons of the tractor and parts making industries. There should be men with long experience of selling, men who are authorities on the automobile system of parts manufacture, assembly, and so on. These men should have free hands within very wide limits.

Second comes the engineering organization. This the S. A. E. alone could supply to-morrow. The proper specifications, having regard to all angles of the case, could be drafted within a couple of months. If the word to go was given July 1, the first standardized tractors could be shipped before December. Nor would it be necessary to restrict present tractor output to any extent while the various manufacturers are making the necessary preparations.

The scheme is admittedly idealistic, but it is the prerogative of America to turn the impossible into the actual. As an engineering task it is no greater than others that have been accomplished successfully. It is as nothing when compared with the organized munition production of the Allies at home and abroad.

Industrial Supremacy and Moral Standards

(Continued from page 1208)

will calm the apprehensions and spur the courage and determination of your clientele, you will have it in your power to make a contribution to this aggregation of our industrial and other resources in a common cause, which will be second to no contribution made by any group in the country. And I am not asking you to forbear criticism. A declaration of war is always a declaration of an open season for critics, and that is rather fortunate. There are no perfect people, and all of us who are imperfect are anxious to have their imperfections called to our attention, so that we can be more on guard against them, and people who are exceedingly busy about great tasks are quite likely to allow their natural imperfections to run away with them, while they are absorbed about other things.

But make it constructive. There is a man in my country from whom I learned more than from any man I ever knew, I think. He bought a house in the country, and decided that it needed a new roof. It was a very humble place, and as soon as he decided that the existing roof would not do he got a ladder and got up on the roof and tore it all off; and when he got down to the bottom of the ladder he realized that he had not yet thought of buying a new set of shingles, and it was a long time before he could either get the money together or get his friends to bring the new shingles out to him, and in that time the rains came and the winds blew, and every makeshift device that he could provide did not keep him from catching cold and ultimately dying from exposure. Make your criticism helpful and constructive; point out the way to do it right when you discover that it is being done wrong, and do not spare us who are here charged with responsibility, if after you have pointed out the right way to do it we persist obstinately in continuing to do it the wrong way.

But I started out with a quotation from a philosopher, Mr. Balfour, and I want to end with that, not as a lost thread, but to show at least that I remember how I started out with these remarks that I am making here. Mr. Balfour was uncertain whether there was any such thing as progress; he was uncertain whether these vast engines and in-

tricate machines which we have devised were not over-mastering the better part of us and making us a nation of mechanics and geniuses, rather than a happy people; and I said that the answer to that question was going to be given by this war. America has a chance to match her wits against the wisest people in the world now. Our inventors who have loaded the Patent Office from garret to cellar with the most brilliant manifestations of ingenuity that the human mind has ever seen, in times of peace and pleasantness, are now summoned to do their very best in order that American ingenuity may be contributed as a great national asset. Our industrial captains, and our great commercial people, our farmers, all of us from the most important to the least of us in all trades and occupations now have an opportunity to put our hands on the rope that is pulling civilization out of the fire.

Organization for a Great Purpose

When war is over and there assembles in some stately place and around some marble table a company of men to make peace, if at that table there sits a man who is entitled to speak as the representative or an America which has co-ordinated itself, and demonstrated to the whole world the invincibility of a democracy like ours—if, from the section at that table at which America sits, an authoritative and compelling voice can be heard to say that all of the mechanical inventions and all of the ingenuity of mankind is to be made its servant, is to be used to produce and keep a permanent peace, is to be used in the making of better conditions for men and women and children to live under, and find the highest development of all their powers unobstructed by unholy national ambitions, if that kind of voice can be heard with authority and compulsion in such a council, then truly our country will have organized itself to some purpose, for we will have vindicated the political philosophy upon which we have been founded, and in which we have lived, and we will have settled the doubts of philosophers about this spectacular application of human ingenuity and mind to the development of mechanical side to the comfort of mankind.



French trucks leaving the Cama at Lyons preparatory to making a short run for the purpose of instructing recruits in the fine points of driving war trucks in proper convoy formation

The Cama—World's Greatest Automobile Organization

This Is the Automobile Supply Department of the French Army in the Field—Two Centers, Paris and Lyons
—How the System Operates

By W. F. Bradley

EDITOR'S NOTE: Unusual interest attaches to this intensely analytical and comprehensive article, as the information was obtained by Mr. Bradley, special representative of THE AUTOMOBILE with the Allied Armies, by permission of the French War Department. Before it could be forwarded to the United States the manuscript was submitted to the Ministry of War and approved. All photographs used in illustrating the article were approved by the French censors.

CAMA is the name applied to the great automobile organization which stands back of the French army in the field. That organization is the biggest the world has ever seen, or probably ever will see, for France makes a greater and more varied use of automobiles than any of her Allies, or enemies, in the field.

The cama is the huge automobile supply department of the French army. When the United States becomes sufficiently involved in the war to need a cama it will establish that department at Detroit. But France possesses two automobile-producing centers, the greater one being at Paris and the lesser at Lyons. Thus she has a cama in each district. The latter one, with which this article is particularly concerned, receives automobiles from the Lyons factories, from Italy, and from the few makers in the centers east and west of France. It differs from Paris in that it handles neither metropolitan nor American makes.

Between the factory which produces automobiles and the army which uses them there is this important and extremely useful organization. Trucks and passenger cars are not placed on freight cars and shipped direct from the factory door to the war zone—at any rate, not under the highly developed war system prevailing in France. The cama places contracts with the various factories; it receives fleets of complete cars or chassis as the case may be; it tests every one; it equips them much more carefully than the private automobilist fits out his car for a long tour; it trains drivers for these

vehicles; it forms them into convoys in charge of competent officers, and finally it sends them out, complete in every respect, for active service in the war zone.

Fiat, for instance, is one of the most important suppliers to the cama; but as these factories at Turin are supplying the Italian, English, Belgian, Russian and probably also the armies at Salonica, with various types of vehicles, it is more advantageous that they should send the standard chassis, without attempting to equip it to suit the requirements of the individual armies. The Lyons factories, which are located almost at the door of the cama, do not always produce their own bodies. Thus, instead of allowing these factories to send their chassis to a local bodymaker, the cama takes delivery of them in the first place, passes contracts with the bodymakers, and incidentally supplies most of the raw material, and attends to the detail equipment in its own shops.

To American eyes this may seem a needless complication and a source of additional expense. But in other and similar organizations, where supposedly complete American vehicles are handled, the same preparations have to be gone through. Not one of the American cars or trucks is equipped exactly as the army wants it, and even if they were correctly equipped, the cama would be necessary in order to verify them, to supply them with drivers, and to send them away as self-contained units capable of following an army anywhere.

It has been proved, however, that the army can get

better service and cheaper service by equipping its own vehicles than by getting them complete in every respect from the factory. I was given examples of this in lamp brackets, in spare gasoline can carriers, in tool racks, and in various other fittings, all of which could be made by the army cheaper than manufacturers could supply them. In arriving at prices, standard rates of wages were calculated, and not an estimation of the cost of the soldier to the State.

On the day I first visited the cama there was a display which could not have been better staged if it had been done on purpose to impress. In the main avenue were lined up forty Fiat field ambulances, completely equipped and ready to leave for the front. In another avenue were twenty Berliet trucks and one repair truck, also ready to go out on active service. When I returned, 24 hr. later, the ambulances had disappeared and their place was occupied by a long line of Fiat 15-20-hp. chassis which had been verified and were about to pass into the body builders' hands; in place of the finished Berliet trucks there was a row of Peugeot chassis ready to have their equipment fitted.

Transformation Is Continuous

This transformation goes on day after day with unfailing regularity, one or several convoys going out every 24 hr. and bare chassis coming in with almost the same uniformity. In the grounds of what had once been a French Coney Island, truck chassis to the value of about \$1,000,000 were to be found under tarpaulins ready to go into the body-making and fitting shops.

Another department of this organization deals with repairs only. France has organized one immense central clearing station for all automobiles which cannot be repaired by the traveling workshops attached to the convoys in the field. From this clearing house the wrecks are sent to the repair departments of the different camas, where they are completely overhauled and most of them sold to contractors engaged in supplying the army. Not very many of these vehicles sent out of the war zone are ever sent back again. On the other hand, convoys which have suffered heavy losses in the field are sent to the rear to be reequipped and sent out again with the same men and the same vehicles.

When chassis are received from the manufacturer they are supposed to be mechanically perfect. But nothing is taken for granted. Each shipment is taken on the road for a test run of about 30 miles, an experienced army officer being in charge and a factory driver at the steering wheel. This trip is not intended to test the endurance of the chassis, but just to assure that nothing has been scampered or neglected, and is a guarantee that when the convoy goes on the road the army driver will not have to tinker.

Lubrication is verified, for some makers are not above practising such small economies as putting the smallest amount of grease or oil in the gearset, the rear axle, the engine, steering gear, etc. Close reck-

oning is sometimes carried so far that the amount of gasoline put in the tank is only just sufficient to go from the factory to the gates of the army depot. Sometimes the quantity was short by 50 yd., when the army had to supply a spare can, until the officers refused to consider any vehicle delivered until it was inside the grounds.

Accessories Made in Army Shops

Obviously no changes have to be made on the chassis, nor does the body need any modifying; but important work has to be done by the cama in the equipment of the cars and trucks. No automobile manufacturer makes his own accessories, so that there is no advantage in allowing the truck maker to buy his lamps from Jones, pay one of his own men to fit them and then sell them to the army. The automobile section of the army goes direct to Jones and buys its own lamps, and not only lamps, but jacks, tools, sponges, oil cans, horns and the thousand-and-one accessories required on cars and trucks. This system has been extended so that the army now makes many of its spare parts. In any case, the army would have to supply the factory with raw material, for under present conditions the Government practically has a monopoly of all metals; thus it is cheaper to keep the material and make the parts in the army shops. In other cases stampings and castings are received in the rough and machined at this central supply depot. Again the cost is lower, even when estimating wages at the rates paid in the open market.

All the men employed in the workshops are the older classes who could not in any case be called up for service at the front. As far as possible maimed men are given a chance, for France has seriously tackled the problem of giving a new start to men who have suffered some physical disability while fighting for the country. Al-



Upper—A number of convoys of light trucks being fitted up at the Lyons Cama. Note the uniformity of equipment on each vehicle and the steel wheels and bumpers
Lower—Trucks to be taken out by novice drivers for training. The truck at the right is the examining officer's vehicle

though this is a purely military establishment and every worker from the most skilled engineer to the roughest laborer has a military rank, female labor is not refused. The example can be found on even a bigger scale in the civilian establishments.

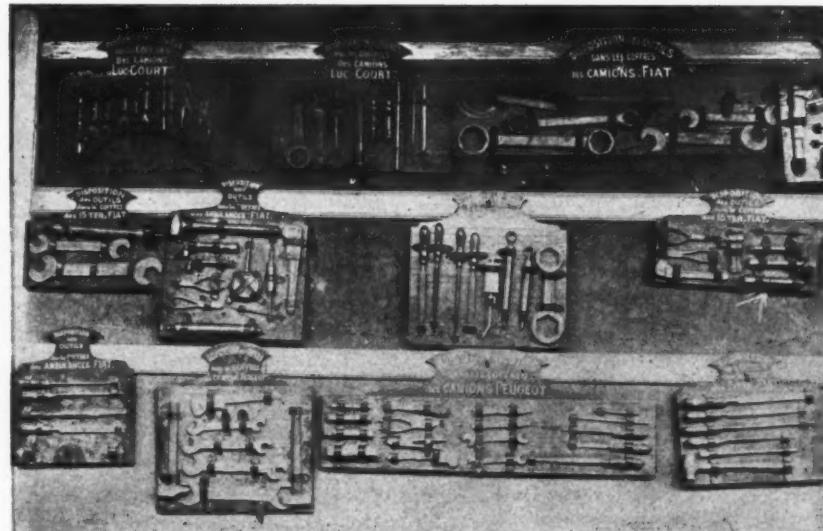
The system of tools and spares developed by the "cama" is remarkably interesting. The guiding principle is that the convoy, which may consist of twenty to thirty trucks, shall have everything necessary to keep it working under the best conditions, but that the individual drivers shall not be given a single tool more than is necessary. Wood models have been made of the tools which accompany each make of truck. These comprise a set of wrenches, screwdrivers, a couple of files, grease gun, oil can, big shifting spanner, valve remover, etc. They vary a little according to the makes, but in no case is an unnecessary tool supplied. In the carpenter shops tool-carrying boards are made for each type of truck. These are hardwood boards with the place of the tool scooped out, and leather to hold the tools in position, according to the plan generally adopted in workshops. These tool racks have to be hung in one of the lockers under the body overhang, and each man is responsible for his own tools. On inspection day the officer in charge can tell at a glance whether any tool is missing or not.

Economizing on Spare Parts

With the exception of a few spark plug washers, no spare parts are given to the drivers. It is found that this is the only satisfactory and economical way to handle vast fleets of army vehicles. To make each vehicle self-contained the driver would have to be given a wasteful wealth of parts; if a selection is decided on, the probabilities are that on not more than 1 per cent of the occasions would the driver have the part required.

All spares are put in charge of the mechanics aboard the repair truck attached to the convoy. This stock includes everything liable to wear or breakage on active service. There are three sets of all ball bearings used in the truck, front axle assembly, steering gear, two magnetos, magneto parts, carbureter and carburetor parts, a complete gearset, a radiator, crankshaft, cam-shaft, pistons, connecting-rods, valves, valve springs, radiator hose, water pump, gaskets, bolts, nuts, washers, spark plugs and various small parts.

All these spares are packed in specially made boxes in such a way that they cannot deteriorate no matter how



Model tool layouts for various makes of trucks. These are the only tools given to the truck drivers. Note how easily absence of a tool can be noticed

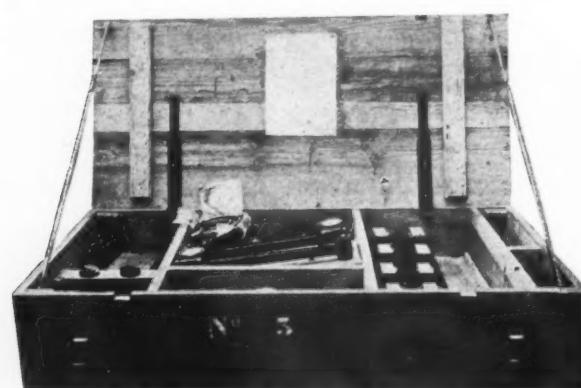
long they are kept out of use, and so that the mechanic can control his stock merely by glancing in the box. Spark plugs, for instance, are screwed into a shelf; valves are set up in a suitable sized hole, complete with spring and cotter. Inside the lid of each box is a printed list of the contents, and in addition the driver keeps a list of his stock and a record of all parts given out. On the sides of each box are four inverted U-forged irons to receive a couple of bars by means of which the biggest box can be conveniently handled by a couple of men. When operating from a fixed base the spare parts boxes can be stored with the knowledge that their contents cannot be tampered with, and when on the road they will all fit inside the repair truck.

Every truck going on active service carries two 50-liter drums of gasoline as a reserve supply—this being equivalent to about 26 gal. The drums are a stout galvanized iron type used by the gasoline refiners and having a couple of screwed brass stoppers. They are laid on their sides in a special cradle under the overhanging portion of the truck body. They cannot roll or chafe, are not likely to leak, and are instantly available when required. It is understood that this supply shall be kept for emergencies, as for instance when an advance is made and the ordinary supply of gasoline cannot be brought up to keep pace with the convoy.

Instruction in Driving Trucks Essential

As important as the preparation of the trucks is the instruction of the men to handle them. If America puts an army into the field, it is practically certain that she will accept for her automobile service only those men who have had previous driving experience. France has had to mobilize every able-bodied man within her territory, and those responsible for her military policy have always considered that a man's physical qualifications as a fighting unit were more important than his experience as a motorist. The important question is, "Can the man fight?" and if the answer is in the affirmative the man goes into the firing line, whatever his qualifications as a motorist may be. Those who cannot fight, because of age or physical disability, are turned over to the automobile section to be shaped into drivers.

Men who have never before driven an automobile, who probably never have even ridden in an automobile, are passed into the schools and must come out 15 days later capable of driving in convoy formation at the front. Obviously, the system is not ideal, as many critics are



Spare truck parts packed in the box in which they are sent with the convoy going to the front. Spares are not given to the driver but carried in the repair truck of the train



Ambulance convoy which has just been passed through the Cama and is now ready to be placed in the medical corps of the transportation department at the front

endeavoring to point out; but the military authorities consider it the best under the circumstances. The school instructors, who are certainly the best qualified to judge the system, are not found among the grumblers. Said one of them, who admitted that he had instructed 12,000 drivers: "With the material they give us it would be hopeless were it not for the determination of the men to become efficient. We have a certain number of young men who are turned over to us because of wounds received at the front; they are good material, and it is quite easy to train them in 15 days and with only 30 hr. actual driving. But most of them have passed or are approaching 40, and are agricultural laborers, or farmers, with no knowledge of automobiles. All the metal workers and wood workers, who would have natural aptitudes for driving, have been taken out. When I first realized the kind of pupils I had to deal with I was in despair; but every one of these men is as anxious to become proficient as we are to get him through his course on time. Some of these men can only barely read and write, yet they all buy automobile text books and study them nights. If you had to creep into their quarters you would find that there was only one subject of conversation—automobiles and automobile driving."

"Enormous Determination to Succeed"

Not one, but a dozen instructors, questioned individually, expressed the same opinion: "Few natural qualifications, but an enormous determination to succeed." Said one instructor: "About 25 per cent of these men fail to get better than a second-class driving certificate during the time allowed in the school. Yet of these all but 5 per cent pass first-class after a fortnight on the road. Our worst pupils, you will perhaps be surprised to hear, are not illiterate farm laborers but lawyers who have reached middle age without doing any manual labor."

A big open space, without obstacles and with a few hills, has been turned over to the instructors as a training ground. As the men have to be turned out efficient in 15 days, work goes on from 7 in the morning till 5 at night, with a break at midday, and is never stopped because of weather conditions. A few

days before there had been heavy snow and frost, but it made no difference to the school; conditions were harder for the learners and valuable for the advanced pupils. The value of an open space for training is that accidents are rare. When the men can steer straight, they are made to drive the cars between blocks of wood placed on the ground; practice in hill climbing and gear changing is obtained on a hilly portion of the ground which gives all the advantages of the road without any of its dangers.

The first two days are spent on touring cars in order to learn the use of the different pedals and levers and to steer a straight course. Truck driving

follows, the last few days being spent on roads of a rather difficult nature and with the make of truck the pupil will have to drive when he leaves the depot. Only the necessary theoretical instruction is given to make the men competent drivers, it being recognized that men can perform very valuable service at the front without having any conception of magneto construction, gear ratios or volumetric efficiency.

Few Previously Connected with Industry

Comparatively few of the officers in charge of this central supply depot were professionally connected with the automobile industry before the war. Many of them were engineers in other branches, and they are all of them enthusiastic, competent and independent in their views on automobile design and construction. Most of them have had long experience with convoys at the front and have the defects and qualities of every make—French, English, American and Italian—at their finger tips. Unlike men professionally connected with the industry, they are free from prejudices and do not hesitate to point out the defects of supposedly perfect makes and to give praise where it is due to comparatively unknown manufacturers.

They are unanimous in stating that the most common defect, and the one from which every make suffered, particularly in the early stages of the war, is the breakage of stub axles due to crystallization of the metal. Hard driving, roughly paved roads and the constant dropping into shell holes were responsible for this. The trouble has been largely overcome by more correct designing of the parts.

Abrupt changes in the section of frame members al-



Ambulance chassis under canvas covers at the Cama and awaiting their turn to have bodies mounted



Trucks at the Cama. Some are still as they were received from the maker, without bodies or accessories. They will soon be fitted with army bodies and then sent into active service. Such transformation goes on constantly day after day

ways brought about breakages. In the repair shop one truck built by a high-class maker was pointed out with the rear springs carried in a recess of the frame; although there was a liberal supply of metal and the horizontal section was broad, the frames always broke at the bend when subjected to the strain of active war service. On another truck the frame cracked at the point where the front shackle of the rear spring was riveted to it. One leading American and one well-known French make were reported to give trouble owing to the breakage of crankcase arms. This was overcome by interposing stout coil springs between the arm and the main or subframe, thus giving a flexible instead of a rigid mounting.

The 5-ton truck is condemned for war service. It is cumbersome on ordinary roads and is destructive of road surfaces. The 3½-ton type generally employed is sufficiently big for all purposes; some of the officers are of the opinion that a 2½-ton model would be even better.

American trucks receive a considerable amount of criticism. Design is frequently poor and gasoline and oil consumption always extravagant.

Full-Pressure Oil System Preferred

Full-pressure oil system was considered far superior to circulating type, for the least obstruction was liable to cause this latter to break down, and if the truck had to work at an unusual inclination the rear cylinders were flooded and the forward bearings ruined.

Wood wheels are considered fit only for trailers occasionally made use of behind the heavy trucks. Cast-steel wheels are not only cheaper but are much more satisfactory under every kind of war service than are the wood type. Some little trouble has developed with cast-steel wheels having hollow circular section spokes, these spokes showing a tendency to fracture. A section roughly in the form of a cross is more satisfactory. Steel disk wheels for pneumatic-tired trucks are well spoken of. Some of the officers, however, who have had lengthy experience with this type of wheel state that the lateral rigidity is not all that could be desired, and that there is a tendency for them to break in the angle. Notwithstanding this, they are considered far superior to the wood variety.

Pressure-feed gasoline supply is condemned, particularly if the pressure is taken from the exhaust. There is

always water from condensation in the pipe, and in winter this water freezes and gives endless trouble. Unit construction of engine and gearbox is strongly condemned, not because of any deficiencies in the field but because of excessive labor involved when any repairs have to be carried out.

A Novel Electric Plant

THERE is a very novel individual electric plant built by the Electromatic System Co. of Chicago, Ill. The plant is not only desirable for lighting, but for power, heat and battery charging in view of the fact that it delivers standard 116 volt d. c. current. The plant is automatic in the manner that heretofore has never been accomplished. It eliminates the bank of storage batteries floating on the line. The reason that batteries are not necessary is due to the fact that the plant starts wherever a demand for current is made, and continues to deliver current until the last demand for current is turned off when the plant comes to rest; in other words, it runs when being used and stops when not in use, and during the time of operation the governor maintains constant speed of the engine, so that the voltage remains the same, regardless of load.

Last winter when the Willys-Overland Co. purchased the stock of the Overland Motor Co. of Chicago, which was owned by C. W. Price, the trade here awaited the announcement of the automobile which would be distributed by Mr. Price. Instead of continuing in the automobile business Mr. Price heads the Electromatic System Co. as its president. A. S. Johnson who was made general manager of the Overland Co. for the past 5 years is vice-president and secretary. C. H. Chamberlain, treasurer, was retail sales manager of the Chicago Overland Assn. The plant embodies not only economy and convenience but safety as well, since it is equipped with a Stewart storage vacuum tank which enables fuel to be carried outside in an underground tank.

Commercial Assurance 1917 List Out

THE Commercial Union Assurance Co., Ltd., London and New York, has issued its 1917 list of automobiles, trucks and electric passenger cars, showing the model, type of body and list price, with the horsepower and collision insurance ratings. The book is of interest also to those who wish to get information on the older models, some of which go back as far as 1911. Most of the foreign cars are also listed. The New York address of the company is 55 John Street.

Advantages of Hydraulic Transmission for Tractors

Ability to Obtain Great Speed Reduction with High Efficiency May Render This Type of Gear Ideal for Tractor Service

IN its elemental state, a hydraulic transmission consists of a pump and a motor. The pump delivers a definite quantity of oil, under pressure, per revolution. The motor is driven by this oil. If the displacement per revolution of the motor is double that of the pump the reduction in speed effected will be in the ratio of two to one; if the motor is four times the capacity of the pump it will be four to one, and so on. Thus we can get any ratio we may require by making the displacements per revolution of pump and motor in the correct proportion.

With a hydraulic transmission, efficiency bears practically no relation to ratio. We can have a motor fifty times the size of the pump and still hope for between 80 and 90 per cent efficiency with a fifty-to-one reduction of speed.

Hitherto, most hydraulic transmissions which have been built experimentally for trucks or passenger cars have had as their main point the variability of ratio. This is obtained, as a rule, by having a pump of variable capacity, so that the amount of oil delivered per revolution varies. When the full stroke of the pump is used, and the motor is of the same capacity as the pump, we

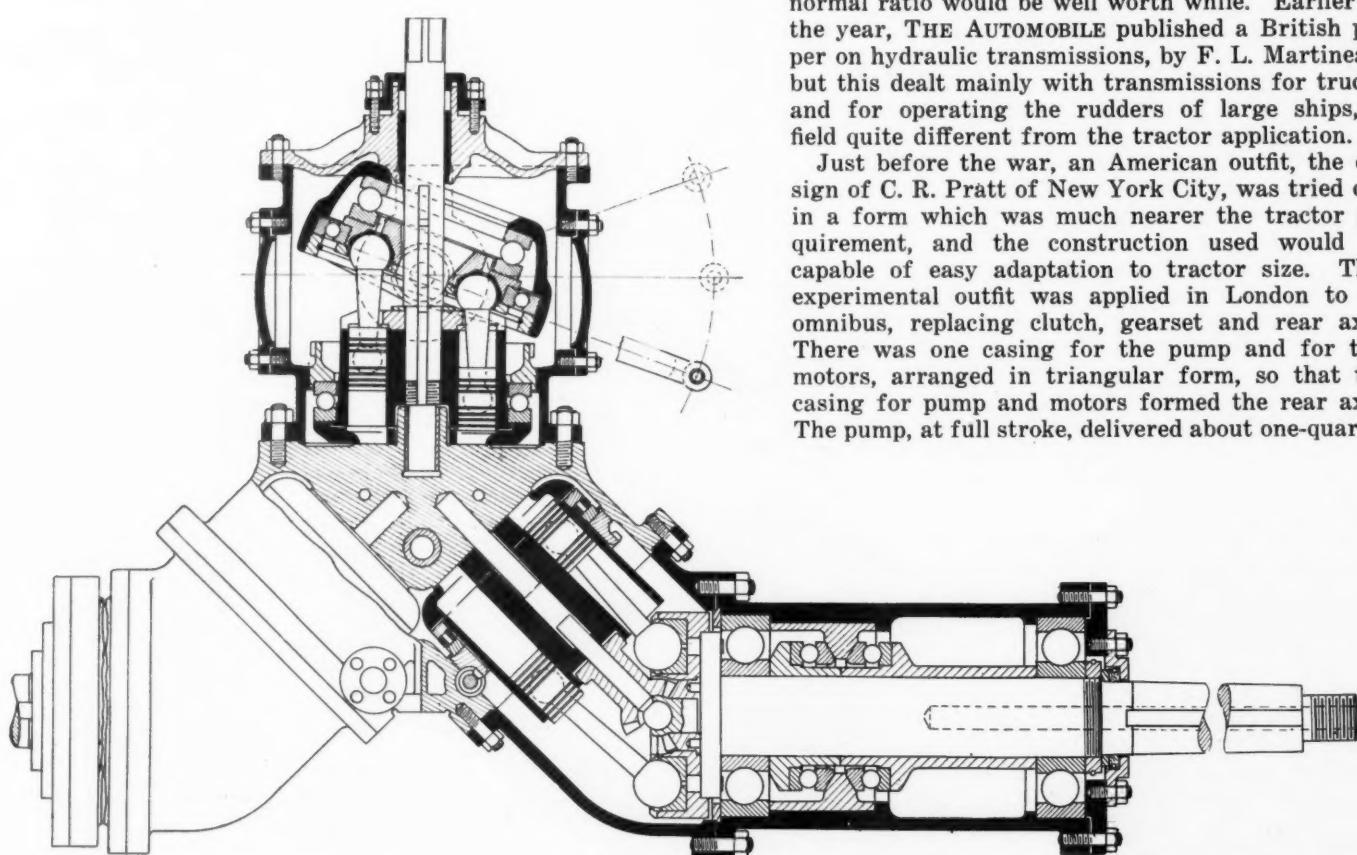
reach a stage where there is no speed reduction. Then, if the pump stroke is reduced by some means, the delivery becomes less than the motor capacity, and a reduction in speed ratio results. But the efficiency of the pump falls off as its stroke is reduced, because the leakage remains constant, or nearly so, and it consequently becomes a bigger and bigger percentage of the total delivery as the latter is reduced.

But if a pump and motor are designed to give a definite reduction with full stroke of the pump, the efficiency is just as high for fifty to one as for one to one. The variable reduction can be retained, with corresponding decrease of efficiency, as the ratio is lowered below the minimum reduction obtained at full pump stroke, but this means that we could have fifty to one with, say, 85 per cent efficiency, and 150 to one with perhaps 60 per cent.

Average Gear Efficiency 50 Per Cent

Now, the average tractor on its highest speed has an efficiency in transmission not exceeding 50 per cent. Some attain a 60 per cent efficiency, but only a few manufacturers claim more than fifty. This being so, it certainly appears likely that a hydraulic transmission which would be even only 70 per cent efficient with normal ratio would be well worth while. Earlier in the year, THE AUTOMOBILE published a British paper on hydraulic transmissions, by F. L. Martineau, but this dealt mainly with transmissions for trucks and for operating the rudders of large ships, a field quite different from the tractor application.

Just before the war, an American outfit, the design of C. R. Pratt of New York City, was tried out in a form which was much nearer the tractor requirement, and the construction used would be capable of easy adaptation to tractor size. This experimental outfit was applied in London to an omnibus, replacing clutch, gearset and rear axle. There was one casing for the pump and for two motors, arranged in triangular form, so that the casing for pump and motors formed the rear axle. The pump, at full stroke, delivered about one-quarter



Pratt hydraulic gear fitted to truck in use five years in New York

as much oil as the capacity of the two motors, and fed each equally, so the highest ratio obtained was approximately four to one. Practically the same design would apply to a tractor, but the capacities of the motors would have to be increased greatly. On page 1227 is shown a section of an earlier model which has been in use on an express truck in New York for several years. This is considerably more complicated than later designs. The large ball bearings, which would obviously be costly, have been eliminated, and several details changed which assist inexpensive production.

The action is as follows, irrespective of the details of the design: There are seven pump pistons and cylinders, and the cylinders are in a single block, capable of rotation around the common center. The upper ends of the pump connecting rods are secured in sockets in the disk shown, and the angularity of this disk relative to the center line of the driveshaft from the engine is variable. If the disk is at right angles to the shaft which drives it then the pistons and cylinder block will rotate without any motion up and down of the pistons, and no oil will be pumped. If the disk is set at 20 deg., the pistons will reciprocate through the full stroke, once during every revolution of the unit, pumping the maximum capacity of oil.

In the bottom of each small cylinder there is a hole, and this registers with ports in the casing beneath as the cylinder block revolves. By means of these ports the pistons are able to suck in oil on their upstroke and force it out toward the motors on the down stroke. Consequently, there are two chambers for oil; one contains the pumped oil under pressure, and it is this that supplies the motors; the other contains the oil discharged from the motors, which is not under pressure.

Motors in Parallel

Both of the motors are connected to the same pressure chamber, and the construction of the motor is similar to that of the pump, except that the angularity of the connecting-rod-drive disk relative to the cylinder block is fixed at 45 deg., and is not variable. Suppose, now, that the pump delivers 100 cu. in. of oil to the pressure chamber in one revolution. Oil being practically incompressible, this means that the pistons, on the out stroke in the motors, must move far enough to accommodate that 100 cu. in. of oil. How much of their total stroke this may be depends upon the relative capacities of pump and motors. But the motor pistons cannot move without rotation of their cylinder blocks, so the latter will revolve in proportion to the amount of stroke of the pistons. If the total piston displacement of the two motors is 400 cu. in., then the motor cylinders will each turn a quarter revolution for one revolution of the 100-cu.-in. pump.

Reversibility is inherent, and is obtained by changing the direction of angularity of the pump-driving disk. Switching this disk from one side to the other of the neutral, or right-angle position, will cause the pump pistons to discharge into the chamber from which they were previously sucking, and to suck from the chamber which was previously the pressure side. This causes the motors to reverse their direction of rotation, but the range of ratio and the efficiency are unaffected.

Mr. Pratt has devised a very ingenious

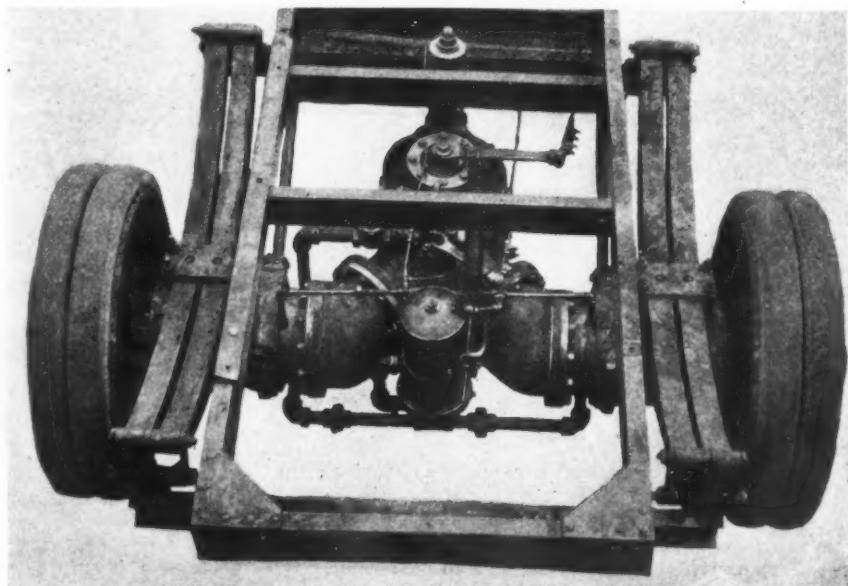
control for this gear, which is completely automatic. In the original layout, the angularity of the driving disk relative to the driveshaft from the engine was set by hand. In starting, the angularity of the disk was increased by moving a lever from nothing to 20 deg. The first slight movement caused the pump to begin to discharge a small amount of oil, and so caused the motors to begin turning slowly; as the engine picked up the load and the vehicle gathered speed, movement of the controller increased the pump stroke to maximum.

Simple Automatic Control

The automatic control consists of a device connected to the pressure chamber between the pump and the motors. The lever for altering the angularity of the driving disk is connected to a piston, sliding in a cylinder in connection with the pressure chamber, so that the piston is forced outward by the oil. A hand lever is arranged to push this piston inward via a compression spring, and this means that the actual angularity of the pump-driving disk is decided by the balance of pressure applied by the spring in one direction and by the oil in the pressure chamber in the other direction.

Thus to start the machine, the hand lever is pushed right over; the pump immediately begins to discharge, and the pressure in the chamber runs up rapidly. This forces out the control piston and reduces the disk angularity, so decreasing the pump delivery. As the vehicle gathers speed the pressure in the chamber will drop, the spring will force the piston in, and the angularity of the disk will be increased again. The effect of this is automatically to maintain the torque in the motors independent of the speed. The pressure cannot rise above a maximum in the oil-delivery chamber, and it will remain at the maximum all the time as long as the engine is operating at full throttle. Thus, with a truck or tractor, the engine being started it would only be necessary to throw the control lever once. As soon as a grade or obstruction was encountered the resistance would increase, the pressure rise, and the angularity of the disk be decreased, effecting a drop in gear ratio. As the resistance slacked off the ratio would change back again. One has the ability to apply the full power of the engine running at its full speed, whether the vehicle is standing still or moving at its maximum pace.

The objections are weight and cost. The former would



Pratt transmission used on London bus

necessarily be considerable, because the pump and motors would have to be a fair size. To get some idea of what this would be a unit actually made for an engine of 30 to 40 b.h.p. had seven pump cylinders $1\frac{3}{4}$ by $1\frac{3}{4}$ in. approximately. To get a thirty-to-one ratio, as the minimum, the motor pistons would have to displace thirty times as much. As there are two motors, each with seven cylinders, this means that each cylinder would have to have fifteen times the capacity of the pump cylinder, or fifteen times 4.2 cu. in. = 63 cu. in. This condition would thus be satisfied by motor cylinders 3.5 by 5.7 in. This in turn would probably mean that the outside of each motor casing would be about 18 to 20 in. diameter; not so large when considered by comparison with other forms of tractor gear cases.

As an offset to the weight of the case there is the complete elimination of clutch, all gearing and differen-

tial, for the pair of motors are inherently differential in action, being fed from a common pressure chamber. Another possibility which might be worth considering would be to introduce one gear between each motor and its respective rear wheel, instead of driving direct onto the axles. A spur-gear reduction of two to one on each rear wheel would permit the size of the hydraulic motors to be halved, but there would be the power loss of the gearing to be considered.

On cost, the gear appears to be such that it could be produced fairly cheap if put on a production basis. Nearly all the individual parts are simple, and there is little that has to be extremely accurate. It is almost wholly a lathe job, with a minimum of milling or boring. As already stated, modified designs simplify the bearing layout a great deal and permit the use of smaller diameter bearings.

Oldsmobile Has Benefit Association

EMPLOYEES of the Olds Motor Works at Lansing, Mich., have organized a benefit association under the guidance of the company which is both comprehensive and broad. Known as the Olds Motor Works Benefit Assn., it has for its object the creation and maintenance of a fund for the aid and relief of those members who become ill or injured.

Every employee of the company is eligible for membership. Meetings are held annually on the first Thursday after the first pay day in January, when officers, trustees and directors are elected from among the workers. The trustees constitute the finance committee and dispose of disputed accounts and approve all bills.

The fee for membership is 20 cents, which is deducted from each pay check every pay day by the timekeeper until the amount of the fund exceeds \$1,500 by one assessment, after which assessments are 10 cents until the amount on deposit falls below \$1,000, when the assessments again become 20 cents.

Employees must be members for 10 days before they are entitled to benefits, and no part of the first week's illness or four days of disability is included as a part of the first 10 days. No benefits are paid for accidents occurring outside of the factory. In event of sickness insurance begins on the seventh day from the date of the doctor's certificate, while in case of accident the member may draw his benefit from the date of the doctor's certificate, provided he is off 4 days or more.

\$25 a Year Is Limit

No member is allowed to receive more than \$25 in any one year for sickness or disability produced by chronic diseases. Those members who become disabled by sickness receive \$1 per day for a period not exceeding 50 days, and in case of accident are paid \$1 per day for a period not exceeding 30 days, no member being allowed to draw more than \$50 in case of sickness or more than \$30 in event of accident in any one year. On the death of a member his dependents receive \$50.

Any member who becomes ill or is injured must notify the Olds company's welfare department within 2 days following, and all applications for benefits must be presented in a form prescribed by the association and signed by a regular practising physician, the president of the association and two trustees.

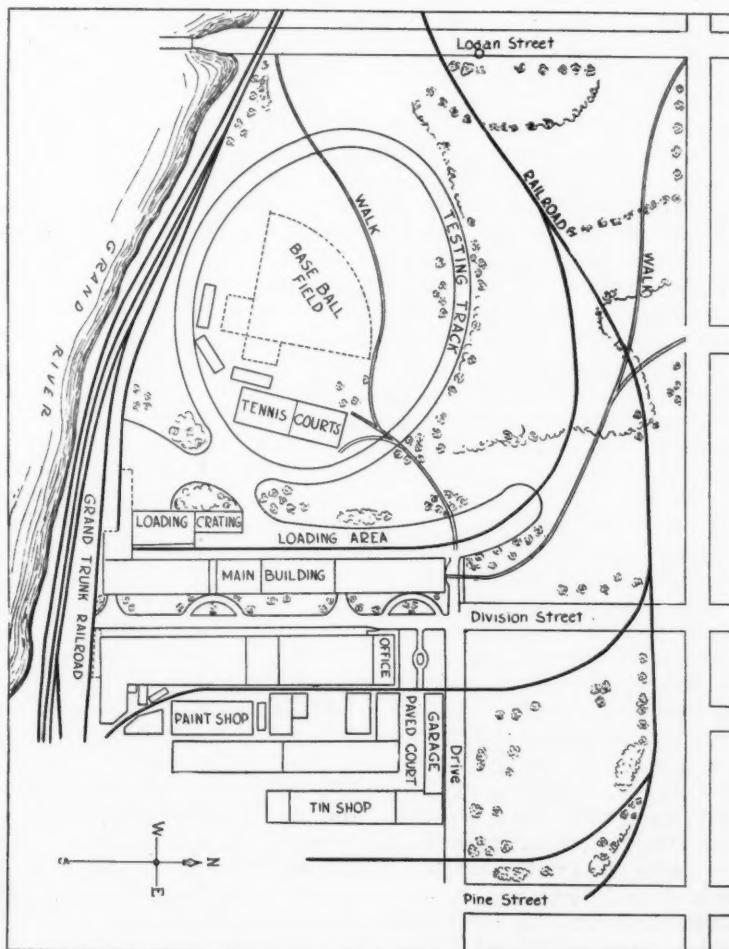
The funds are deposited with the large national bank in Lansing unless otherwise directed by the trustees.

In addition to the clerical supervision of the association, the welfare department makes regular factory inspections as to sanitary conditions and carries on educational work for accident prevention. It also attempts to make amicable settlements between merchants and

employees with a view to eliminating the troubles of garnishments, and in this has been very successful, the last 2 months having passed without a single garnishment.

The company plans to construct in the near future a dining room for all employees, where they will be able to purchase food at cost. Rooms are now provided where employees may eat their lunches which they bring from home.

The grounds in and about the plant are being beautified and a baseball park, tennis court and general recreation field will be built this spring. An Olds Motor Works baseball league has been organized by the workers.



Plan showing recreation area at Olds plant

Much Learned in Standard Car Test

Curves Made with S.A.E. Standardized Apparatus Indicate Detail Condition of Engine, Disclose Qualities of Springs, Demonstrate Smoothness of Brake Action

By David L. Gallup and A. Ludlow Clayden

BY a long process of alternate elaboration and simplification the standard form for car testing was brought to a degree of perfection sufficient to satisfy the S. A. E. standards committee at its last meeting. It represents the work of over 2 years by the research division, work done in committee, on the road and on the speedway.

The instructions for the test read as though it would be an elaborate performance to put a car through the schedule. Experiment shows that it is extremely easy and simple. In a single hour everything that a car can do in acceleration and deceleration with every sort of carburetor adjustment and ignition setting can be recorded. Half an hour is more than enough for attaching the testing apparatus, and in an ordinary way an hour would suffice to fit up the machine, test the car and remove the apparatus. Not more than two persons are required, one to drive and the other to handle the testing machine.

These are the conclusions after a 2-day tryout on Narragansett Park Speedway at Providence, R. I., experimenting with five different cars.

The economy test is, of course, a longer job, but it is just as easy. With the average automobile the high-speed tests are soon completed; it is only the runs at speeds below 20 m.p.h. that are tedious. Still, to make a complete and exhaustive series of tests for economy and for acceleration would not occupy more than an easy day on a speedway unless it was desired to make a great quantity of adjustments to the engine.

Testing Apparatus Simple

The testing equipment for acceleration consists of three parts: an attachment to the front wheel, made in the same manner as the front drive for a speedometer, a recording unit on a board which is placed in the tonneau, and a storage battery.

The front-wheel attachment consists of a make-and-break of the old-fashioned sort, and the gearing is such that five sparks are produced at every front-wheel revolution. On the recording board there is a roll of paper moved by a small electric motor, and a chronometer marks off seconds with a pen on this paper. The speed of the paper may vary, may be fast or slow, the only difference is the space between one second mark and another, which, as will be seen, does not matter.

From the make-and-break on the front wheel connection is made to a high-tension coil, and the discharge from this punctures the paper at a place adjacent to the line being drawn by the pen. Each revolution of the front wheel makes five sparks, so making five punctures in the paper; so, by counting the number of punctures between one second mark and the next we know the number of revolutions and fifths of revolutions of the

wheel. The circumference of the wheel is checked by running the car for ten or more revolutions and then measuring the distance. Thus, knowing the number of revolutions of the wheel in any second marked on the paper by the chronometer, we have merely to multiply by the circumference to get the distance traveled in any second, and so the velocity for that second.

In acceleration testing, as the car starts, the first second marked off will contain a comparatively small number of punctures, the second a larger number, and so on. Thus it is an easy matter to plot both velocity and acceleration curves. Velocity is obtained by multiplying the number of punctures in each successive second by a constant, and acceleration follows from the difference in the velocities between one second and the next. One beauty of the system is that the driver has not to bring the car to a very accurate speed. If he wants to start at 5 m.p.h., he will run as steadily as he can at about that speed. On getting the word from the operator that the machine is running he accelerates, and the exact speed from which he started is shown on the record. Suppose he wants to know the acceleration from 20 to 30 m.p.h., the record shows it without the need for watching a speedometer and manipulating a watch; it is far more accurate, also, than any stop-watch and eye combination can ever be.

The economy testing rig has been described before. Two tanks for gasoline are attached to the windshield and connected by cocks to a special carburetor line. One of the tanks is readily detachable, so that it can be removed and weighed, the other furnishes a reserve supply. The operator sits beside the driver, and the car is driven on the reserve tank till the engine is warm and the driver ready. The speed desired is attained as nearly as possible by the speedometer and checked during the run by the watch.

When all is ready, at the instant of crossing a line on the track, the operator turns the two cocks, switching off the reserve tank and turning on the other, which has been carefully weighed. The requisite number of circuits are made to consume 2 lb. of fuel, and on crossing the line again the cocks are turned once more, the car stopped, and the weight of the fuel consumed checked exactly. The speed is determined from the stop watch. This process is repeated for each of the speeds to be tried, the length of time depending, of course, on the economy of the engine. Like the acceleration machine, the economy apparatus is easily attached and removed, and the windshield mounting gives an ample head for gravity feed, adjustable within certain limits.

Acceleration Curves Show Great Detail

The amount of detail shown in the acceleration and velocity curves is remarkable; in no case are they any-

thing approaching smooth curves. During acceleration and deceleration, also, the change of velocity is irregular with the test of cars. As yet, just what causes the irregularity is partly a matter for conjecture. In the tests made at Narragansett Park it was noticed that a car with a particularly flexible spring suspension gave very smooth records. In another instance, a brake test showed that axle movement or torsional oscillation of the Hotchkiss drive was affecting the regularity of the brake pressure profoundly. One very interesting curve for acceleration and deceleration shows that natural slowing down is almost as rapid as the acceleration produced by the engine. In making this test, the gear lever was slipped into neutral at the end of the acceleration and the car allowed to coast till nearly at rest. On none of the five cars was the deceleration as great as the 10 ft. per second mentioned in John Younger's recent paper as about the maximum possible with rear-wheel brakes.

Careful study and analysis of the results of acceleration tests, bearing in mind the constructional features of the particular cars furnishing the data reveal some extremely interesting sidelights. In a sense, an article of such nature as this loses a large part of its value, since "names" cannot be called. The reason for this can, of course, be readily understood. On the other hand, there are certain conclusions which apply, and which may be mentioned.

In general, there are three things which have an important bearing upon the results. First, there is carburetion; secondly, spring suspension (including magnitude of unsprung weight); and third, the form of drive.

To the layman, the first is without question the simplest. With this he is quite familiar. How often it happens, when in traffic, for illustration, quick get-a-way is desired, the accelerator is depressed, and instead of a distinct push in the back the engine falls "flat," due either to a lean mixture, resulting in popping, or a rich mixture resulting in surging. With practically any form of carburetor with a fixed setting, one of these will occur under some condition of running. An engine just started up, or one that has been in operation for some time, cold weather or warm weather, etc.—any of these will have their effect. The net result is, of course, expert manipulation of the dash control or a refinement in carburetor design by the manufacturer.

Of no small moment is the combination of carburetor, manifold and cylinder head. In the case of a certain

car, it was very clearly noted that a much smoother curve of acceleration resulted (Fig. 11) than in certain others. With this car, which has from many standpoints an ideal layout, demonstrators have shown the possibility of a speed range from less than 1 m.p.h. to over 60, either low or full throttle at low speeds, good economy, and regular action no matter what the manner of manipulating the accelerator. This is, to say the least, somewhat unusual, and may well serve as an incentive to many designers.

While, as a general thing, an increased number of cylinders always makes for a smoothing out of carburetor irregularities, producing a more uniform acceleration, yet instances have been noted where a car with fewer cylinders gave better results, not only as to smoothness but magnitude, also, than one with a greater number of cylinders. This was true even though the effective horsepower per pound of car was greater in the case of the latter. Refer to Fig. 11, made with a six-cylinder car, and Fig. 3, made with an eight-cylinder car.

The manner in which the accelerator is depressed is something which may well be given attention by engineers. It is a fact that the majority of engines will not respond as well to a sudden and complete opening as though the action were gradual. Be this due to whatever fault, it is something which the average driver should appreciate and be governed by accordingly.

If fuel is to continue in its downward journey of true quality, and carburetion cannot be made to keep pace, it is true that in certain instances a much better performance may be obtained by the use of a dashpot connection between accelerator pedal and throttle arm rather than a mechanical one. This can be adjusted so as to permit a definite maximum rate of opening regardless of how the foot or hand acts.

This list could be carried out almost indefinitely, and each item discussed at considerable length. The result, however, would always be the same, and the conclusion that much as we have progressed in the art of engine building there is still a big opportunity for the carburetor and engine designers to get together and produce a combination which will better performance at the small end of the range. To-day, in the average car, we have all the power we need, at least all we ought to have, and sometimes good economy. We don't however, get the *pull* at low speeds under adverse conditions of road and weather.

The second item, spring suspension, has its effect in a somewhat peculiar manner. This may easily be illustrated by the attempt to accelerate the same car over a smooth road and a rough pavement, in one case on the

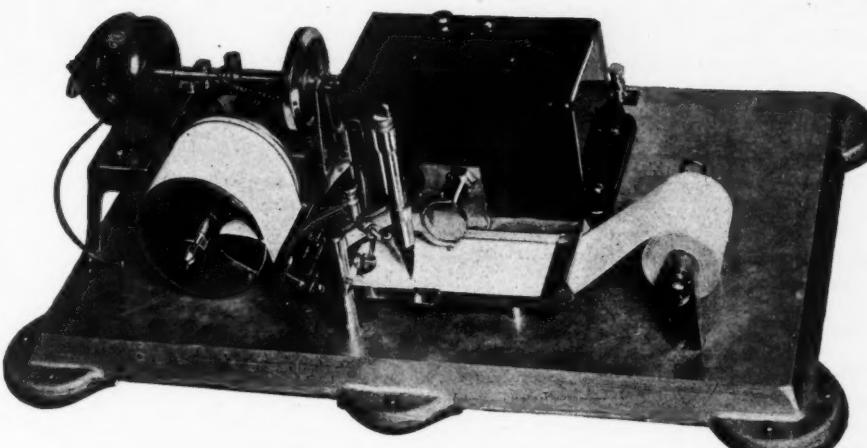


Fig. 1—Acceleration and speed-recording apparatus carried in tonneau of car. The pen in front marks seconds; the spark punctures the paper back of the pen.

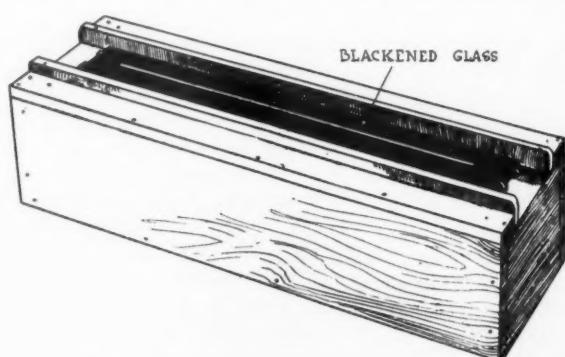


Fig. 2—Box on which paper strip is placed for counting punctures. Light comes through from beneath blackened glass.

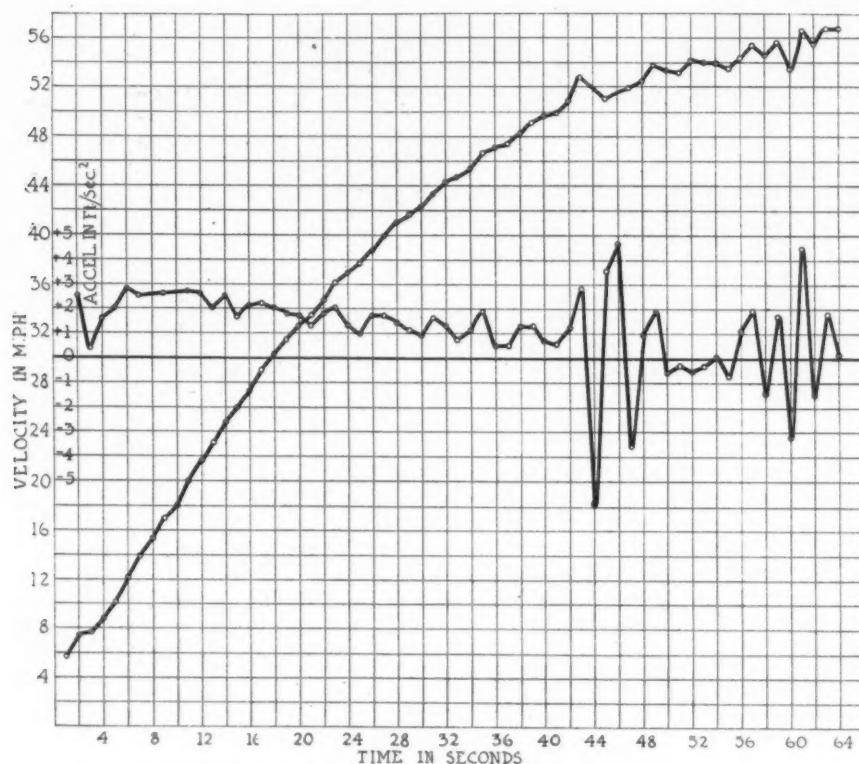


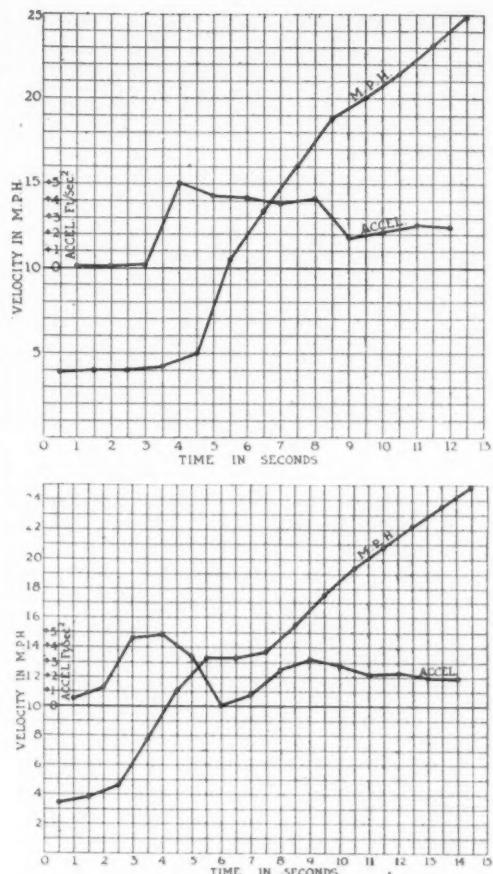
Fig. 3—Eight-cylinder car in high gear. Maximum acceleration about $2\frac{1}{2}$ ft. per sec. per sec. and maintained between 10 and 25 m.p.h., following in general in its magnitude the general shape of the torque curve which in turn is nothing more or less than a duplication of the mean effective pressure curve. It will be noted that at 45 sec. there was considerable variation in the acceleration curve. This is due to bouncing and wind. The total effect of this is described later in the discussion. Even though this test was conducted on an asphalt slab track, and to all intents and purposes absolutely smooth, the unsprung weight was so great and the spring suspension so stiff, that the bouncing was noticeable to the passenger in the car. Cord tires were used. Above, Fig. 4—Six-cylinder, through gears. This is an extremely good shift, shifts being made at the 4th sec. and 7th sec. The time element was extremely small. Below, Fig. 5—Six-cylinder. Through gears; shift was made

level and in the other case on an incline. The difference will be a revelation to the average driver. Since with the modern car light unsprung weight usually goes with a flexible spring construction, such cars will hold the road under all conditions much better than the other type.

The action in the case of heavy unsprung weight and stiff springs is peculiar. Assume, for a moment a car of this type on a rough pavement, and the throttle is suddenly opened. The rear tires are put under extraordinary stress, and as obstructions (unevenness) are encountered they tend to bounce. As they bounce, traction is either entirely or nearly lost, and under the influence of full throttle either spin or at least slip. The car, of course, temporarily loses headway. When again traction is restored a distinct impetus is given the car. This continues throughout the range, so rapidly, however, as to be perceptible to the passenger only in the form of a jar or vibration, which he attributes to the rading rather than what is indicated. This continual release and absorption of power sets up vibrations which literally "kill" the effectiveness of the drive.

Power Absorbed in Vibration

A peculiar comparison came to light some years ago at a large stationary locomotive testing plant. When in operation at the equivalent of approximately 60 m.p.h., the indicator diagrams showing something like 1000 hp., there was no drawbar pull recorded! Taking into account all of the ordinary mechanical losses, it left the conclusion that most of the power was absorbed in vibrations of the heavy machine.



from low to intermediate from the 4th to the 6th sec. This was a poor shift and was affected also by the fact that the shift had to be made across the H. Bad carburetion existed to such an extent that the engine went flat. The dash adjustment was resorted to with the result that when the shift was made from intermediate to high between the 10th and 11th sec., and which incidentally was a very rapid shift, the better carburetion and the better shift are evident, the former showing up by producing an acceleration greater than existed in test 4 which was made on the same car

The same is true with the automobile, only, naturally, in a lesser degree. With cars having stiff springs and heavy unsprung weight there is a marked difference in the performance over smooth and rough roads under load. There is also a difference under this condition with the other types of car, but this difference will be less in the latter case than in the former.

Drive Is Less Important

The third item, form of drive, is of lesser importance than those already mentioned. The greatest difference is shown in cars taking the reaction through the springs, sometimes semi-elliptic, and sometimes full. In addition, there is a distinct difference when one universal is used instead of two.

An instance was noted in the case of a steam-driven car in which the engine was supported at one end on the rear axle and at the other end on the car body. At the instant of throttle opening there occurred a distinct "lift" to the car body, aided, of course, by the springs. When the body had completed its upward motion it began to settle, aiding during its descent the effect of the steam in driving the car. This set up a sort of periodic oscillation which can be distinctly seen on some of the curves. This is not necessarily a detriment to car performance; its existence is indicated here merely for the purpose of explaining some of the peculiarities in the curves.

Taken all in all, such an investigation reveals some extremely interesting information in a given car. Even with what limited experience has been available it is readily seen that many characteristics hitherto unexpected

may not only be shown up but explained and remedied, if such be desired. The relation between carburetor lag, torque, and gear ratio can be studied with a good deal of profit. It is quite possible that with conditions tend-

ing as they are, the relation between high, intermediate and low may be radically changed from the stereotyped and accepted amount, and with advantage to not only the used but car also.

Standard Form for a Complete Car Performance Test

CAR PERFORMANCE TEST SPECIFICATION SHEET	
No.	Date of Test
GENERAL DATA	
(a) Car—(Name, year, model)	Stock Yes... No...
(b) Manufacturer (Name and location)	
(c) *Location of course	
(d) *Weight of car alone	
(e) *Number of passengers in full complement	
(f) *Weight of full complement of passengers	
(g) Total weight (includes d and f)	On front axle..... On rear axle.....
(h) Tires (make and trade name)	Stock equip. Yes..... No..... Size—Front..... Rear.....
(i) *Pressure in tires (lb. per sq. in.)	Right front..... Left Front..... Right Rear..... Left Rear.....
(j) Carburetor (make and model)	Stock Equip. Yes..... No..... Size.....
(k) System of fuel feed for carburetor.....	Stock equip. Yes..... No.....
(l) Ignition system (make and model)	Stock equip. Yes..... No.....
(m) Gear ratio on highest gear	Stock equip. Yes..... No.....
(n) Size of engine bore	in. Stroke..... in.
	Number of cylinders..... Total piston displacement (cu. in.).....
(o) Horsepower rating (N. A. C. C.)	
(p) *Fuel	
(q) *Lubricating oil (trade name and grade)	
(r) *Weather..... Temperature.....	
(s) *Barometer..... in. Hg. *Relative humidity..... per cent	
(t) *Wind velocity..... Direction.....	

*For interpretation of headings see "Explanatory Notes and Definitions."

1—Each portion of the test shall be made upon an automobile speedway or other course surfaced with wood, brick, concrete, asphalt or an equivalent material. In case it is not possible to secure suitable conditions for both the fuel economy and acceleration runs on the same course, they may be conducted upon separate courses.

2—Whatever course is used shall be such that in no portion shall there exist at average grade of over 3 per cent for a distance of not over 50 consecutive feet. Wherever the average grade for a distance of not over 50 consecutive feet ex-

ceeds 1 per cent, the course must be in the form of a complete circuit.

3—The entire test, including the fuel economy runs and the acceleration runs, shall be performed between sunrise and sunset of the same day.

4—The entire test may only be run at a period during which the wind does not exceed a velocity of 15 m.p.h. measured at the nearest U. S. Weather Bureau Station. The average values of humidity and barometer shall be obtained from the same source.

5—During the entire test the car must be run with all tanks full and carrying its full complement of passengers or corresponding ballast. Full complement of passengers shall consist of one passenger or the equivalent for each seat provided, driver included. The average weight for passenger and driver to be 150 lb. each.

6—During the entire test there must be no change in gear ratio, ignition, carburetor, or any other detail of the car or its equipment. This shall not be interpreted as prohibiting changing spark plugs or manipulation of spark and throttle levers.

7—A car fitted with an inclosed body must have all windows and doors closed during runs.

8—A car fitted with an open body must have the top up and windshield fully erected during the runs. Rear curtain must be fastened down. Side curtains must not be used.

9—The pressure in the tires shall be that recommended by the manufacturer of the tires used, corresponding to the load applied both front and rear.

10—The same gear ratio between the engine and ground shall be used throughout the entire series of runs.

11—At no time during the runs shall coasting, declutching or the use of brakes be permitted.

12—Oils and greases used in the engine, transmission, rear axle or other parts of the car must be of usual quantity and quality.

13—The whole of the fuel used during the test must be of one quality. A sample of the fuel shall be taken for the purpose of determining and recording its specific gravity. The

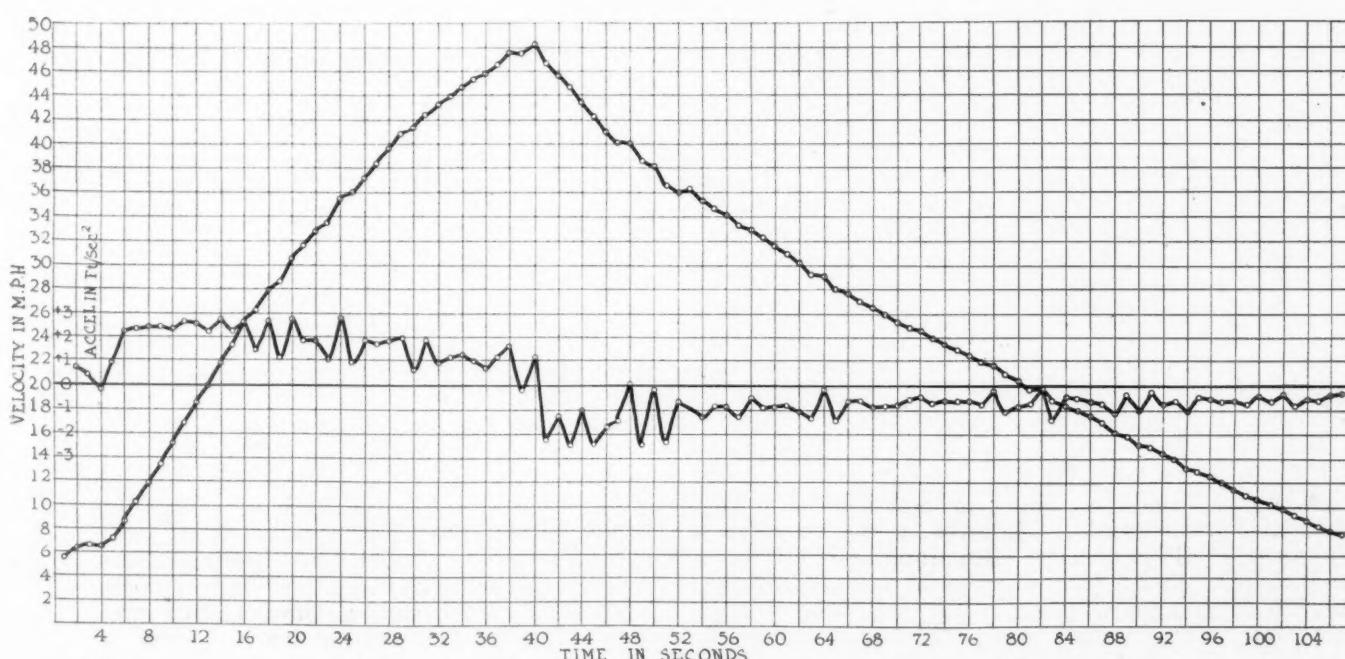


Fig. 6—Acceleration and deceleration curves made with an eight-cylinder car

The trade name of the fuel used shall be given. Wherever possible information relative to its heat value must be furnished; also a curve showing the results of a fractional distillation test.

14—All fuel used during the test must be fed from the special tanks placed on the windshield. (See description of apparatus under fuel economy run.)

15—Previous to beginning any run of the test, the engine is to be operated sufficiently long to bring it to the normal temperature corresponding to the conditions existing during that run.

16—The entire cooling system must be fully operative during the test both as regards air and water circulation.

17—From the beginning to the conclusion of the entire test (including both the acceleration and economy runs) there shall be no manipulation of any carburetor adjustments or control other than the throttle.

Fuel Economy Runs

18—The fuel economy runs when conducted upon a speedway shall be made so as to complete each run at a point identical with that of starting. Each run shall be made without any interruption.

19—When conducted upon a course approximately straight the runs shall be arranged so that each shall be completed at a point identical with that of starting. In each run there shall be no interruptions except those necessary for turning. Any such course shall have an exact length of 5, $2\frac{1}{2}$ or $1\frac{2}{3}$ miles in one direction. The exact length of the course must have been determined by surveyors' chain.

20—The length of each run must be such that at least 2 lb. of fuel are consumed.

21—The fuel consumption shall be measured at a series of speeds covering the entire range of the car from the minimum to the maximum, following in general the outline in the table:

M. P. H.		M. P. H.	
1st run.....	Minimum speed	6th run.....	35-40
2d run.....	9-11	7th run.....	47-55
3d run.....	14-16	8th run.....	63-70
4th run.....	19-22	9th run.....	Maximum speed
5th run.....	26-30		

NOTE.—In case the maximum speed is less than that indicated in any of the other "runs" the latter shall be omitted from the test. In any event, however, a run is to be made at the maximum speed of the car.

22—Fuel shall be fed to the carburetor during the runs by

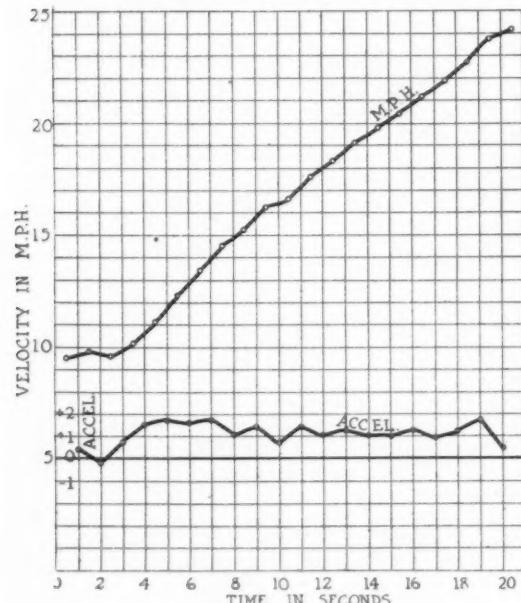


Fig. 7—Another six-cylinder. Low acceleration, but uniform. The carburetor was set lean. This test was made on a car which had been driven 25,000 miles. The high gear only was used. The long mileage undoubtedly had a deterring effect upon the performance due to the universal joints and similar parts not being in as good condition as might be desired. Fabric tires were used. The smooth acceleration curve is accounted for by the very flexible spring suspension and the light unsprung weight which permits the rear wheels to maintain themselves on the ground.

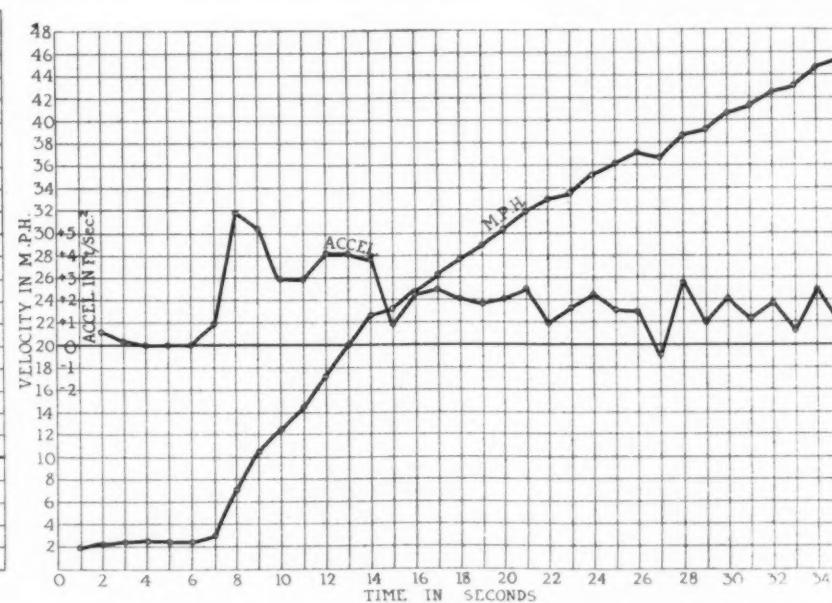


Fig. 8—Eight-cylinder. Tested through gears. Shift was made from low to intermediate at the 9th to the 11th sec., and from intermediate to high at the 14th to the 15th sec. This was, as a matter of fact, a very poor shift. The engine dragged and much time was lost. In this connection it may be well to indicate that although ordinarily at the instant of shifting, negative acceleration occurs, it is for so short a period that the instrument does not catch it. If a stop watch is used on the operator shifting gears, the interval will be found to be very small, and since the intervals for which calculations are made are at the least 1 sec., it will be seen that anything which occurs within a second is not properly recorded. This does not explain the fact that in this test, although shifting took in one instance 2 sec., there is no negative acceleration shown. This is because the engine was racing while shifting was being accomplished, aiding probably in propelling the car by dragging

gravity and shall be supplied from a weighing tank mounted so that the actual distance between the top of the float chamber of the carburetor and the bottom of the fuel chamber is not less than 12 in. The tank shall be such that the variation in head during a run shall not exceed 12 in.

23—There shall be two tanks, preferably mounted side by side as shown in the accompanying sketch. These tanks shall be connected to the carburetor so that by means of two cocks or their equivalent, one tank may be "cut in" and the other "cut out" simultaneously. Of these two tanks one is a reserve tank used for maneuvering when measurement of fuel is not being made. This tank may be a fixture if so desired. The other is a weighing tank to be used during the runs for the measurement of fuel. This must be capable of easy detachment so that it can be weighed and replaced without difficulty. It must be large enough to contain fuel sufficient to enable the car to complete its run at maximum speed without refilling.

24—The procedure relative to the tanks is as follows:

Each tank is to be filled with fuel. After filling, the weight of the weighing tank with fuel is to be accurately determined and recorded. It is suggested that a carefully calibrated spring balance be used. Following this the weighing tank is to be mounted in position.

The engine shall be brought to the normal temperature of the run and the car to the speed of the run before crossing the starting line, on fuel from the reserve tank. Upon crossing the starting line the reserve tank shall be cut out and the weighing tank cut in.

Repeat in Case of Interruptions

When the course is such as to necessitate interruptions in the run due to turning the same procedure shall be repeated at each end of the course.

Upon crossing the finish line at the conclusion of each run the weighing tank shall be cut out. It shall then be removed from its attachment and with its contents carefully weighed. The weight of the fuel consumed having been recorded, the tank may be refilled and weighed again previous to the commencement of the succeeding run.

25—Before the commencement of each run a setting of the throttle shall be determined which shall give the average speed desired for the run. During the run this setting shall remain fixed. The time for each lap is to be checked by the

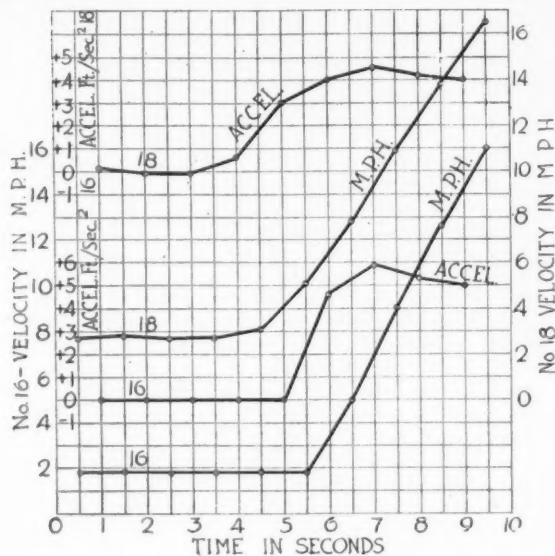


Fig. 9—Six-cylinder car on intermediate gear. A comparison between the accelerations in the various gears: an acceleration in high of approximately 2.2 ft. per sec. per sec.; in intermediate, 4 ft. per sec. per sec., and in low 5.5 ft. per sec. per sec. All of these curves follow in general outline the torque curve, and taking into consideration the various efficiencies in the various gears (engine to ground) the ratios are reasonable

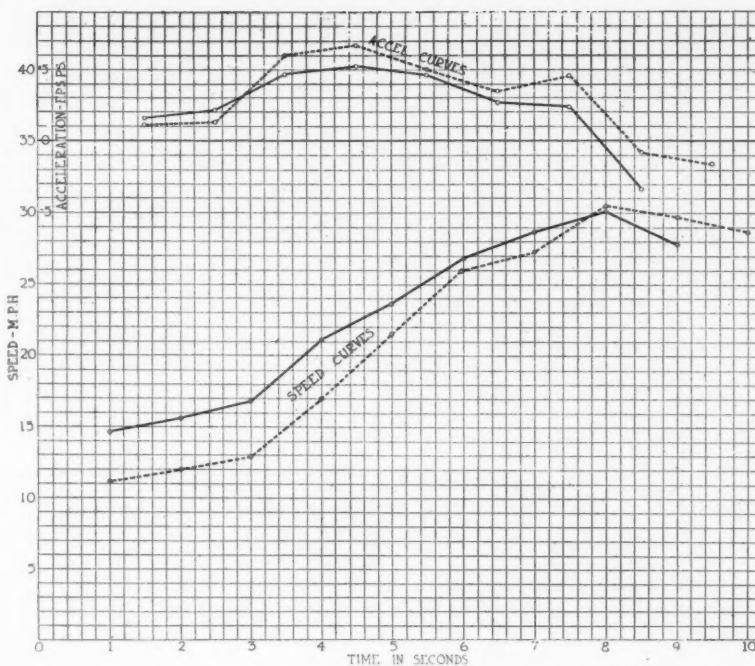


Fig. 10—Curves obtained from 6-year-old steam car

observer and in no case must the time of the slowest lap exceed that of the fastest lap by more than 10 per cent of the latter.

Acceleration Runs

26—When a complete circuit is used for the acceleration runs such circuit shall be not less than 2 miles in length. Each acceleration run when conducted upon such a course must be started at the beginning only of the straight portion of the circuit. Consecutive runs shall be made in the opposite direction, using the same straight portion of the course.

27—When a straight course is used, each consecutive run shall be made in the opposite direction, using the same portion of the course.

28—There shall be five series of acceleration runs as follows:

Series I—The first series of acceleration runs shall consist of four, made consecutively on the same course, reversing the direction each time, starting at a constant speed*, equal to the minimum speed obtained in the economy runs, which shall be maintained for a period of at least 10 sec. after which acceleration shall begin and continue for 50 sec.

Series II—The second series of acceleration runs shall consist of four, made consecutively on the same course, reversing the direction each time starting at a constant speed* of between 9-11 m.p.h. which shall be maintained for a period of at least 10 sec. after which acceleration shall begin and continue for 50 sec.

Series III—The third series of acceleration runs shall consist of four, made consecutively on the same course, reversing the direction each time starting at a constant speed* of between 14-16 m.p.h. which shall be maintained for a period of at least 10 sec. after which acceleration shall begin and continue for 50 sec.

Series IV—The fourth series of acceleration runs shall consist of four, made consecutively on the same course, reversing the direction each time starting at a constant speed* of between 19-22 m.p.h. which shall be maintained for a period of at least 10 sec. after which acceleration shall begin and continue for 50 sec.

Series V—The fifth series of acceleration runs shall consist of four, made consecutively on the same course, reversing the direction each time starting at a constant speed* of between 26-30 m.p.h. which shall be maintained for a period of at least 10 sec. after which acceleration shall begin and continue for 50 sec.

Note.—During the interval when constant speed is being maintained there shall not be permitted a variation greater than 10 per cent of the minimum rate obtained.

29—The data from each of these runs shall be recorded on the banks the form for which is a part of this report.

Description of Apparatus Used

30—A brief description of the apparatus for recording acceleration is as follows:

Attached to the right front wheel is a gear which meshes with another, directly driving an electrical make and break contact. The ratio of the diameter of these two gears is such that the contact is made and broken five times each revolution of the road wheel. This making and breaking of an electrical circuit causes a spark to jump through a strip of paper fed by a motor attached to the main device and which is carried in the car. Upon the same strip of paper are recorded seconds obtained from a special clock carried in the car. Current for these operations is furnished by a storage battery, also carried in the car, but separate from its standard equipment.

By a comparison between the holes caused by the jumping of the spark through the paper with the seconds recorded, calculations may be made, giving directly the average velocity of the car during any second.

In addition to the foregoing there is attached to the accelerator pedal an electrical contact, controlling a pen which records on the strip of paper the exact instant when the accelerator is depressed.

Detailed Method of Operation

31—As indicated in the rules above, the car is to be brought to a constant speed which must be maintained for at least 10 sec. before the accelerator pedal is depressed—the constant speed being obtained by the use of the hand throttle. After at least 50 sec. following depression of the accelerator pedal the car may be brought to a stop by the use of the brakes and preparation made for a run in the opposite direction as required in the rules.

32—Previous to any of the acceleration runs the exact distance traveled by the right front wheel in ten complete revolutions on the course shall be determined by measurement with a standard steel tape.

Method of Calculation

33—The entire calculations are based upon the assumption that the increment of velocity of the car is constant during any second.

Reference to the following will assist in explaining how the results are arrived at:

N = number of holes (fifths of revolution of right front wheel) in any second.

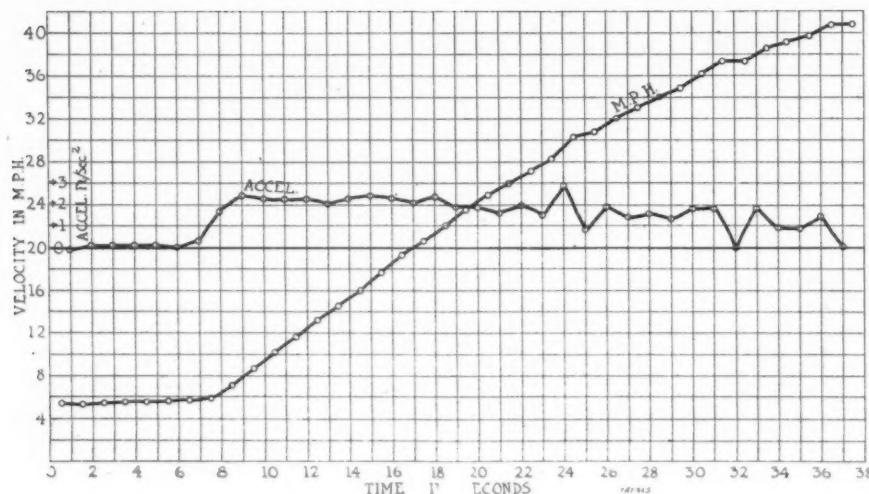


Fig. 11.—Six-cylinder. The performance of this is not as good as was ordinarily found to be the case. As a matter of fact, the Six has much more effective power per pound of weight than exists in the case of the car in Fig. 3, yet the acceleration is as a matter of fact less. This was due to faulty handling of the spark control. It will be noticed that the acceleration curve is fairly smooth. This is accounted for by the fact that the carburetor and header combination is an unusually effective one, leaving little to be desired in the way of flow and quality. The spring suspension is also very good. Cord tires were used

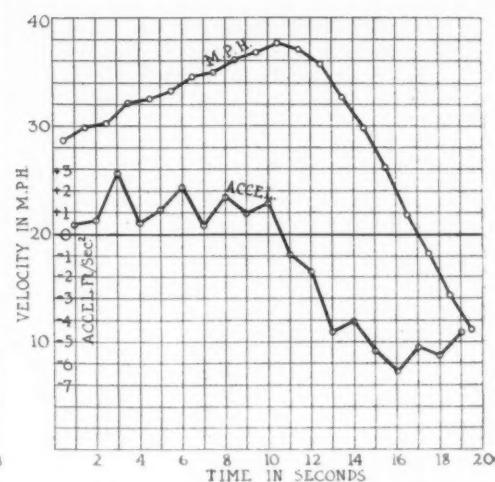


Fig. 12.—Four-cylinder. In this test the engine was not working well, two pistons having been scored, the action therefore being somewhat erratic. Deceleration is fairly good with the exception that the brakes were released as the car reduced in speed. An examination of the track afterwards showed absolutely no sign of excessive braking even though deceleration in this case was of greater magnitude than existed in any of the low gear acceleration tests

N_1 = the number of holes (fifths of revolutions of right front wheel) in the previous second.
 V_1 = velocity in feet per second during any second.
 V_2 = velocity in feet per second during the previous second.
 V_m = velocity in m.p.h. for the same second as is referred to by V_1 .
 C = constant—feet represented by 1/5 revolution of right front wheel.
 A = acceleration in feet per second in any second.
 T = time in seconds.
Then $V_1 = N_1 \times C$
 $V_m = V_1 \times 0.682$

$$A = \frac{V_1 - V_2}{T} = \frac{(N_1 - N_2) C}{T}$$

34.—There shall be one curve plotted showing the results for each series of acceleration runs and shall show the relation between velocity in m.p.h. and time in seconds.

35.—The points forming the basis of this curve shall represent the average velocity in m.p.h. during any second and shall be plotted on an ordinate midway between the beginning and the end of the second in question.

36.—These points shall be connected by straight lines.

37.—All curves included in the entire performance test shall be plotted on the same curve sheet, the form for which is a part of this report.

old industry of Maine and Massachusetts. The revival, or rather the modernization, of the Mississippi River navigation has helped. Everywhere the commercial boat owner is to-day calling for an engine that will burn oil.

Warning Being Sounded

Yet so unsatisfactory have been the individual experiences of those who have bought the undeveloped oil engines rushed out from the factories to meet the call that a cry of warning is following fast in the spreading wake of the booming engine. Its first friends are now becoming enemies. They have not had a square deal. Where the revulsion will stop one cannot forecast. Whether it will gather such force as to overwhelm the whole movement one cannot foretell. Much depends on the industry itself. Were there the influence of a few good powerful firms to counteract the misdeeds of the greater number then the future would be clear. As it is, the outlook is perilous. The safe man will be he who waits until the industry has righted itself. The most successful of the foreign firms doing business here, the firm which has the best of all these engines, is waiting precisely in that way.



Photograph by Press Illustrating Service, Inc.

Above are illustrated three types of tanks developed by the French army to overcome the obstructions placed in its path by the retreating Germans. Wire-cutting prows and creeper-type drives are features of these land battleships

Raising the Mean Effective Pressure

High M.E.P. Aimed At in Airplane Engines—Large Valve Openings, Steep Cams and Stiff Springs Required—Comparison in Automobile Practice

By P. M. Heldt

In order that a gasoline engine may develop the greatest possible horsepower per unit of cylinder displacement it must work at a high piston speed, and the mean effective pressure must be high. In automobile practice most attention seems to have been paid to the piston speed, in the endeavor to increase the output. There are, of course, conditions which make it impossible to carry the mean effective pressure very high in a pleasure car engine. One of these is that such an engine must operate absolutely quietly, which necessitates the gradual lifting and dropping of the valves. Another is that the engine must be quite flexible and run smoothly on low throttle. This puts limitations on the valves which can be assigned to the lag of inlet valve closing and the lead of exhaust valve opening. What mainly limits the pressure in pleasure car engines, however, is the size of the valves. Extremely large valves are somewhat troublesome in themselves, owing to cooling difficulties, and they also lead to bearing troubles, because the high explosion and mean effective pressures which they permit throw heavy loads upon the bearings.

Rotation Speed of Airplane Engines

In airplane engines the speed of rotation has as yet not been carried as high as in automobile racing engines. Conditions of propeller efficiency in the past have had their effect on airplane engine speed. Of course, the direct drive is now used only in certain special types of planes, but, though a reducing gear is nearly always used, there is an advantage in not having the gear reduction too great, in that the losses increase with the reduction ratio. Also, the airplane engines now most in demand are of such enormous output that the individual cylinders are always much larger than in automobile engines, hence the piston speed cannot be carried so high, owing to the rapid increase of reciprocating weight with cylinder displacement.

Stock automobile engines develop a brake mean effective pressure of 85 to 90 lb. per sq. in. at relatively low speed, which drops to 70-75 lb. at the speed at which the engine develops its maximum output. A slightly better showing is made by the Knight sleeve valve motors, which in their stock forms approach 100 lb. per sq. in. at low speed. In racing engines the 100 lb. mark has been passed, though often the horsepower figures given for racing engines do not inspire much confidence. There are some authentic figures, however. Thus we have the results obtained in the Hudson test held last fall, which showed a maximum of about 106 lb. per sq. in. This figure was obtained not from the stock engine but from an engine specially adapted to high speed work by lightening reciprocating parts, enlarging the valves, increasing their lift, etc. This figure tallies very well with that given for the Maybach aircraft engine recently described in British publications, viz., 107.4 lb. per sq. in. This latter engine has five valves per cylinder, located in the head, hence it has very liberal valve passages and a favorably shaped combustion chamber. Its compression ratio

is 4L35:1, which is perhaps as high as the large size of the cylinder (6 by 7.6 in.) permits.

Figures of 130 and 135 lb. brake mean effective pressure have occasionally been given for racing engines, and the former figure is now mentioned by Mr. Coatalen as called for in airplane engines. There is such a large gap between what is commonly accomplished in automobile work and what is claimed for these racing and airplane engines that one finds it difficult to credit the claims.

Suppose we have a piston of 10 sq. in. head area and operating at a speed of 2000 ft. per minute. As only one stroke in four is effective as a power stroke, the motion of the piston under pressure is 500 ft. per minute. With a brake mean effective pressure of 135 lb. per sq. in. and a mechanical efficiency of 85 per cent—which may possibly be attained in large airplane engines—the real mean effective pressure will be 159 lb. per sq. in. and the energy developed in the cylinder per minute

$$10 \times 159 \times 500 = 79,500 \text{ ft.-lb.}$$

The piston displacement during the inlet strokes would be

$$\frac{10 \times 500}{144} = 34.7 \text{ cu. ft.}$$

Now we cannot possibly expect to fill the cylinder to capacity with new charge at each suction stroke. In automobile motors, as shown by numerous tests, the volumetric efficiency at the speed of maximum output is only about 70 per cent. At lower speed the efficiency will be higher and when noiseless operation is not a consideration it may be possible, by means of the free exhaust, rapid opening of valves, etc., to further increase this factor. But we can hardly expect to go beyond 85 per cent. In that case the air actually taken into the cylinder would be

$$\frac{85 \times 34.7}{100} = 29.5 \text{ cu. ft.}$$

Since atmospheric air at normal temperature and pressure weighs about 0.076 lb. per cu. ft. the air taken in by the cylinder per minute would weigh

$$29.5 \times 0.076 = 2.24 \text{ lb.}$$

and this would burn completely

$$\frac{2.24}{15.3} = 0.146 \text{ lb. gasoline}$$

As one pound of gasoline contains about 19,000 heat units (B.t.u.) and as one B.t.u. has 778 ft.-lb. the energy value of this gasoline is

$$0.146 \times 19,000 \times 778 = 2,160,000 \text{ ft.-lb.}$$

Hence the thermal efficiency would be

$$\frac{795,000 \times 100}{2,160,000} = 36.8 \text{ per cent}$$

on the basis of the indicated horsepower and

$$36.8 \times 0.85 = 31.3 \text{ per cent}$$

on the basis of the brake horsepower. Compared with the efficiencies usually obtained from automobile engines these results are exceedingly high. Efficiencies of this order are obtained with Diesel engines, in which the compression is carried at over 500 lb. per sq. in.

To increase the mean effective pressure we must get as much charge as possible into the cylinder, the charge must be of the proper proportion and certainly not too weak; the cooling area of the combustion chamber must be kept down and the charge must be ignited by a powerful spark. Translating these requirements into other terms, the effective valve area must be very large, the valves must be located in the head and the combustion chamber must approach a sphere in form. If these conditions are satisfied the most powerful explosion will be obtained and the least energy will be lost to the cylinder walls.

M. E. P. Increased with Richness of Mixture

The explosion pressure and the mean effective pressure will increase with the richness of the mixture beyond the point where there is just sufficient air to completely burn the fuel to water vapor and carbon dioxide. When there is an excess of fuel there is, of course, a deficiency of oxygen or of air. In that case the hydrogen component of the fuel will burn first, to water vapor, and the carbon component will burn partly to carbon dioxide and partly to carbon monoxide. Taking 1 lb. of gasoline, which contains 0.837 lb. carbon and 0.163 lb. hydrogen, it requires 2.216 lb. oxygen to burn the carbon and 1.302 lb. oxygen to burn the hydrogen. Now suppose there was an excess of fuel of 10 per cent, that is 0.921 lb. carbon and 0.179 lb. hydrogen. Of the total oxygen of 3.518 lb. the hydrogen would now require 1.432 lb., leaving 2.076 lb. for burning the carbon. To burn the increased amount of carbon to carbon dioxide would require 2.438 lb. oxygen and to burn it to carbon monoxide would require 1.219 lb. This leaves 0.857 lb. of oxygen, with the result that

$$\frac{0.857 \times 100}{1.219} = 70 \text{ per cent}$$

of the carbon will burn to carbon dioxide and the remainder or 30 per cent to carbon monoxide. The heat values of the different reactions are as follows:

1 lb. hydrogen to water vapor.....52,000 B.t.u.
1 lb. carbon to carbon dioxide.....14,650 B.t.u.
1 lb. carbon to carbon monoxide.... 4,400 B.t.u.

Now in the case of complete combustion of all of the fuel we have for the heat generation:

$$\begin{aligned} 0.837 \times 14,650 &= 12,270 \\ 0.163 \times 52,000 &= 8,470 \\ \text{Total} &= 20,740 \end{aligned}$$

In the case of the incomplete combustion we have

$$\begin{aligned} 0.179 \times 52,000 &= 9,310 \\ 0.921 \times 0.70 \times 14,650 &= 12,150 \\ 0.921 \times 30 \times 4,400 &= 1,215 \\ \text{Total} &= 22,675 \end{aligned}$$

To get the net available heat in the above two cases we must subtract the heat units equivalent to the energy required to separate the gasoline into its constituents hydrogen and carbon, but this is only a small fraction of the heat liberated on combustion and does not alter the result that the available heat energy of a mixture containing a certain amount of air is greater if more fuel is present than can be completely burned by the air. Of course, if there is a great excess of fuel, then ignition is difficult and combustion is rather sluggish, with the result that explosion and mean effective pressures will be reduced.

It will be noticed that nothing has been said regarding cylinder wall cooling. The effects of this factor on the power are rather complex. If we could be sure of a given volume of charge getting into the cylinder during each suction stroke, then the power output would increase

with the wall temperature up to the point where premature explosions set in, as less heat would be lost through the cylinder walls with higher wall temperature. But as the cylinder walls increase in temperature the charge is dilated more while entering the cylinder and a smaller quantity will get in. With an increase in cylinder wall temperature there arise difficulties of cooling the piston, and as the piston heats more than the cylinder walls, it may bind and cause additional friction. Finally, premature explosions, as indicated by knocks in the engine, also decrease the power. Generally speaking, energetic cooling conduces to an increase in the power.

The brake mean effective pressure will depend also on the mechanical efficiency, increasing with that factor. Mechanical efficiency is primarily dependent upon lubrication. To insure the lubricant retaining its lubricating qualities though subject to high temperatures, castor oil is much used. Probably the practice of using short pistons, the prime incentive for which is the desire to save weight, has a tendency to reduce piston friction as well, because there is less shearing of the film of lubricant. Of course, this relationship can hold only within certain limits, as when the piston bearing area becomes so small that the oil film breaks down, the friction increases again. A further reduction of the friction losses might be effected by the use of ball bearings on the crankshaft and camshaft, but owing to the difficulty of mounting such bearings on the intermediate journals of a crankshaft or integral camshaft they are rarely used.

Up to slightly above 100 lb. per square inch there appears to be no difficulty in forcing the brake mean effective pressure by the use of large valves, steep cams, stiff springs, a combustion chamber with minimum wall area and other generally known expedients. Beyond this point, however, it becomes more and more difficult to secure even a small increase in the m. e. p. Of course, a brake mean effective pressure of about 100 lb. per sq. in. corresponds to a real or indicated mean effective pressure of about 125 lb. per sq. in., so a sharp distinction must be maintained between the two values.

Although, as shown above, the use of an extra rich mixture permits of increasing the mean effective pressure and thus the power of the engine, this fact is of no advantage in airplane engines, because with an extra rich mixture the fuel economy is reduced, and what would be gained in engine weight would be lost in weight of fuel to be carried.

Improved Road Cuts Car Operating Costs One Third

D. E. COLP of San Antonio, secretary of the Texas Good Roads Assn., has been making an investigation and actual tests to show the economy of improved highways in the matter of lessening the cost of operating automobiles and other motor vehicles. In this work he was assisted by experts of the United States Government.

For a basis on which to work, the post road between Austin and San Antonio was taken, and during the month of February of this year a census taken by the United States showed that there was a daily average of 931 cars.

Before the road was improved it took an average of 8 gal. of gasoline for the trip, and now this has been reduced to 5 gal., a saving of 3 gal. per car, which, at 22 cents (the price when the census was taken), means that the saving was 1,006,380 gal., or \$221,403.60. It was necessary to estimate the saving on oil and tires, and this is \$20,000 for the former and \$127,000 for the latter, bringing the total saving on these three items to \$368,403.60 for 1 year.

The most astounding part of this is that the total cost of constructing this road was \$239,800, which means that the saving in one year was \$128,603.60 more than the cost of the road.

Theory of Air and Water Screws

Some Elementary Notes on the Theory of Propellers—Primary Principles Forming Basis of Theoretical and Practical Investigation

By J. Edward Schipper

PLANS have been made by the United States Government to spend upward of \$1,000,000,000 for vessels of the air and water propelled by screws. It is impossible to spend that amount of money in existing plants. New people, new factories and new machinery are to be called into the war-made industry, and not the least of all the problems that will confront the engineering brains of the country will be that of manufacturing suitable and efficient propellers for the various craft by means of which Uncle Sam intends to hold his own on land and sea.

There are certain basic principles of the screw propeller which hold true for both air and water. In fact, most of the fundamentals apply to each, but when it is considered that the density of water is approximately 800 times that of air, it is natural that the same propellers which are the practical application of theory, would not be developed for both purposes. As far as the fundamentals go, though, these propellers follow the same laws.

Pitch and Slip

The pitch of a screw is the height of the helix generated by any point on the screw during one complete revolution. It corresponds exactly with the pitch of a machine screw or a wood screw and is exactly parallel.

When a screw is turned into a tapped thread in a piece of metal it advances the exact distance of its pitch in each revolution. When a water or air screw turns in either of these elements it only advances a certain percentage of the pitch. The remaining amount or the difference between the percentage traveled and the whole pitch or 100 per cent is known as slip. A propeller that advances 80 per cent of its pitch in each revolution has a 20 per cent slip. The relation between pitch and slip is illustrated in Fig. 1.

The propeller disk is the area within the circle of which the diameter of the propeller is a diameter. Assuming the propeller moved for one revolution without slip, in other words, traveled the entire distance of its pitch, this disk would generate a cylinder whose altitude is the pitch. If the path of any point of the propeller were traced on a corresponding cylinder the resulting curve would be a helix. If the surface of the cylinder were developed or rolled out upon a flat surface, the helical line would form the hypotenuse of a right triangle whose base is the circumference of the cylinder and whose altitude is the pitch. The cylinder generated when slip is considered is naturally a shorter one, by the amount of the slip. These elementary geometrical relationships should be clearly in mind in considering the fundamentals of propeller design.

Practical Factors

The purpose of the propeller, whether for marine or air use, is to produce thrust. There are two kinds of thrust: static thrust, which is produced by the propeller when it is stationary, and dynamic thrust, which is produced when the propeller is moving ahead as

on an airplane or motor boat. Dynamic thrust is what is desired for an airplane propeller and the factors which influence the thrust produced are the characteristics of the propeller as made up by the diameter, pitch, and blade area, and, second, the characteristics of the engine as determined by its rotative speed. For any given airplane or boat these factors will influence propeller design. A propeller which is too large or has too great a pitch will overload the engine and will not permit it to develop its proper rotative speed. On the other hand, a propeller which has not sufficient diameter or pitch will permit the engine to race because the load is not sufficient, and the result is that the propeller is apt to fail through centrifugal force.

In determining the diameter of a propeller, whether for airplanes or motor boats, structural conditions must be taken into account as well as the theoretical result. On airplanes the tendency has been to increase the diameter, and while previously aerial propellers have been as small as 4 ft. in diameter, at present it is rare that one of less than 6 or 8 ft. is used.

The most efficient propeller is one that will produce the greatest number of pounds thrust for a given horsepower of the engine. In general, the larger diameter propeller is more efficient than the smaller one. Chas. B. Hayward, in his instruction paper entitled *The Aerial Propeller*, cites tests which show how the efficiency drops off with the diameter from as high as 50 lb. thrust per horsepower to as low as 6 lb. per horsepower.

There are structural disadvantages in propellers of large diameter running at slow speeds, and there are also engine difficulties to be met with. The high speed airplane engine develops its power at high rotative speeds of the crankshaft. On the other hand, the large diameter and large pitch propellers, such as those used in the old Farman machines which were noted for their high efficiency, turned at the slow speed of 450 r.p.m., which of course would be altogether unsuited to the modern engine. It is therefore necessary to adopt a propeller with considerably less efficiency running at a much higher speed. Probably the average modern airplane propeller does not develop much over 8 to 10 lb. thrust per horsepower, although it is both theoretically and practically possible to get seven or eight times this efficiency out of the propeller.

Peripheral Speed a Limiting Factor

It is quite easy to see that another limiting factor on propeller design is its peripheral speed. When this begins to get above 50,000 ft. per min., it takes the best possible material to withstand the stresses, and, contrary to most other structural parts, wood seems to work out better than even the finest metal structural materials.

One of the reasons why the aerial propeller is more efficient than the marine propeller is because the larger diameters can be used in airplane work. In marine engineering the propeller is rarely over 75 per cent effi-

cient, whereas in air practice it is possible to reach 85 per cent. It is impossible to use larger diameters in marine work because of the limitations due to the strength of materials. Take, for instance, an 8-ft. propeller in air use and compare it with what would be the result if a propeller of this diameter were used for marine purposes to transmit the same amount of power. No material known to science would withstand the stresses of such a propeller in the water. The reaction would be directly in proportion to the density of the fluid, and hence would be 800 times greater in the water than in the air.

Inefficiency of Air Travel

When the necessity for using high speed motors is considered, the comparative inefficiency of air travel becomes evident. It was shown by Langley that 1 hp. if properly applied, could carry a weight of 200 lb. at a speed of 40 m.p.h. This is so far beyond practical results that it does not seem to be even within the bounds of theory.

With the conflicting factors of propeller efficiency and engine possibilities to contend with, it is not surprising that propeller design is eventually a compromise. Certain empirical formulae which are part theory and part experience are more of an aid in determining what the best propeller for a given airplane or motor boat shall be than pure theory could ever become. This is true because of the great number of variable factors. Such factors as the pitch-diameter ratio and the ratio of area of the propeller to the area of the total wetted surface in a vessel are known largely by experience. On high speed motor boats these ratios will be different than they would be on slow-going ocean vessels, and experience in design gives an approximation of what the proper ratio to use for any given case will be. On some of the hydroplanes ratios of 1 to 2 for diameter pitch are not uncommon. Such a propeller is used on the 20-ft. hydroplane as the Jay Dee Ess, which has a wheel having 18 in. diameter and 36 in. pitch running at 1600 r.p.m. On heavier boats the ratio is closer to 1 to 1.2.

Lanchester, in his work entitled *The Flying Machine from An Engineering Standpoint*, states the use of empirical material as follows:

"As an alternative and purely empirical basis of treatment, we may fall back on our experience in marine propulsion. There is a practical rule which appears to be

commonly adhered to in the design of marine propellers for sea-going craft of moderate speed. The area of the propeller-disk is approximately 1 per cent of the total wetted surface. This rule has been found by the author to represent a rough average of the practice in various cases, but whether or not it is an accepted rule I do not know. Let us take the case of a flying-machine involving, say, a thrust of 200 lb. at 80 ft. per second; at this speed the frictional air-resistance will be approximately 0.035 lb. per sq. ft. of surface (0.07 lb. per sq. ft. of lamina, i. e., double surface); thus the resistance of the machine is approximately represented by 6000 sq. ft. wetted surface, and, following the rule given in the case of water, the area of the propeller-disk should be 60 sq. ft.; this corresponds to a propeller diameter of about 9 ft. In an actual machine of about this size the propeller is commonly about 7 to 8 ft. in diameter, which, taking everything into account, is in substantial agreement. The propeller employed in flight is of necessity (from considerations of the speed revolution of the engine) of finer pitch than that of best efficiency. Under these conditions theory shows that the correct diameter is less than that of the propeller of best diameter pitch ratio, such as is employed by the naval architect."

Method of Construction

Because the blade of a propeller is helical in shape and must be very closely correct to develop its highest efficiency, the construction of the blade requires a high degree of mechanical skill. Aeronautical engineers consider the blade of a propeller as nothing more than a special form of airplane so shaped that it will travel in a helical path. For this reason the blades are made so that they will conform to the streamlines of a plane traveling in that manner. Propeller blades are concave in order that they will cut into the air and create the least possible amount of disturbance. It is general practice to make these blades of wood, although metal and canvas covered frames have been experimented with to a large extent.

The general method of making the airplane propeller blade is to glue together a number of blocks or boards and then cutting the propeller to the desired lines by cutting away the remaining wood. In glueing these planks together, care is taken that sufficient material is left on each side of the glued section to bring the remaining block to

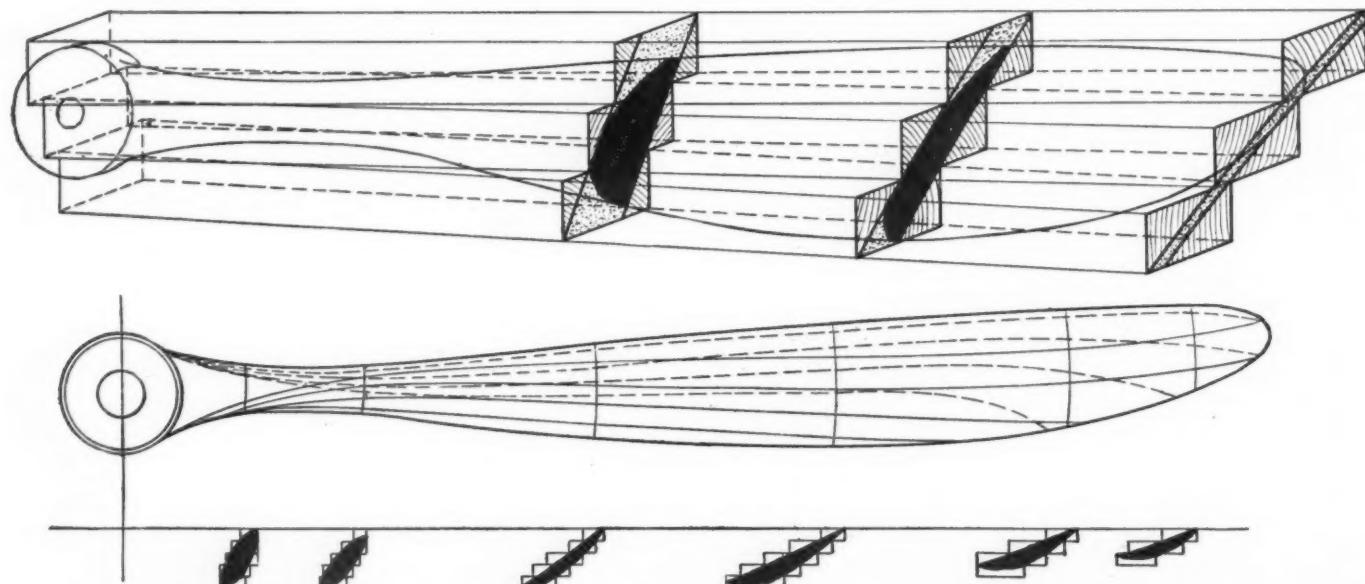


Fig. 3—Diagram showing how a propeller is constructed. The wood blocks are glued together and the sections cut down from them as indicated

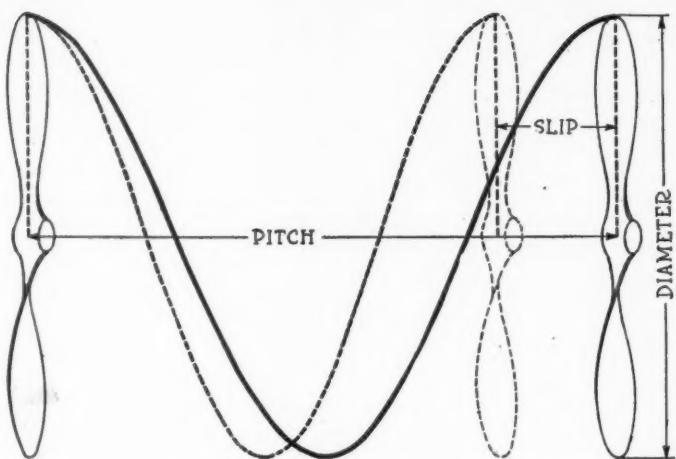


Fig. 1—Graphic illustration showing the meaning of pitch, slip and diameter

the required form. This is done by means of moulds which are fitted to the propeller sections at definite intervals apart along the length of the blade. The depth to which the blades are cut is checked by means of these moulds or templates and the materials first cut away with tools, then scraped with a rasp, and finally with sand-

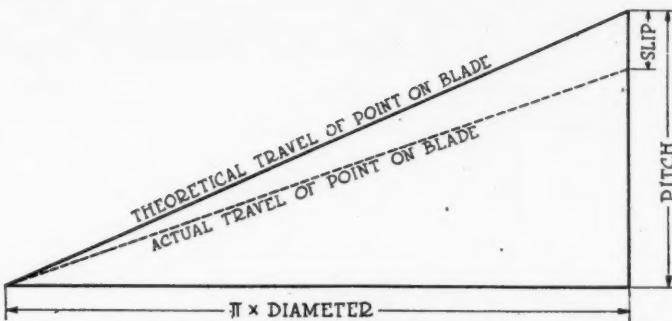


Fig. 2—Diagram showing developed travel of a point on a propeller blade, both theoretical and actual

paper, until the entire surface becomes smooth with the correct amount of curvature at each point.

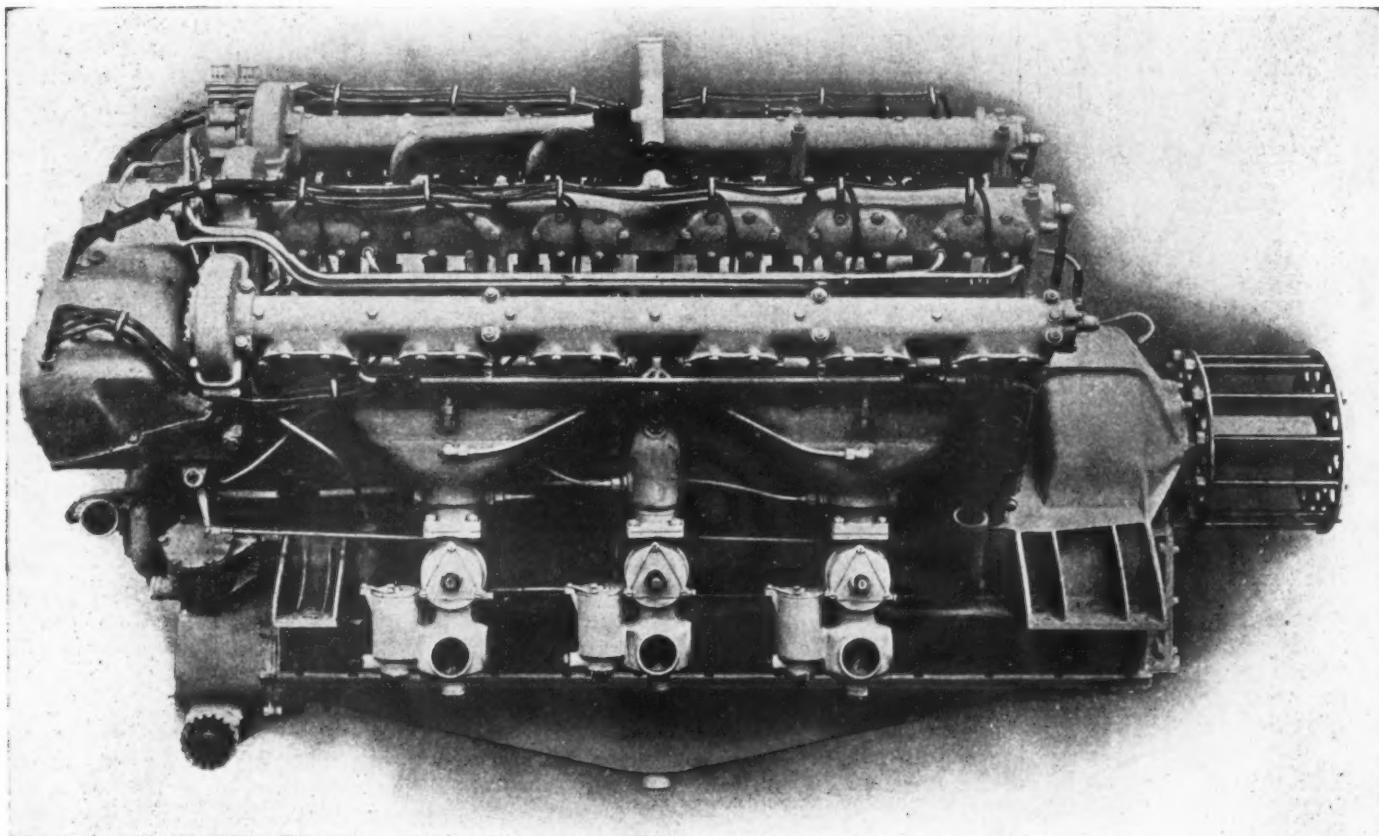
While the aerial and marine propellers are subjects of the deepest mathematical research, the above outlined fundamentals will designate the basic principles about which the theory of the subject is woven. Some of the works dealing with this subject which are recognized as treating it from an authoritative standpoint are:

Aerial Propeller, by Charles Hayward; The Flying Machine from an Engineering Standpoint, by F. W. Lanchester; Air-Screws, by M. A. S. Riach; and The Art of Aviation, by R. W. A. Brewer.

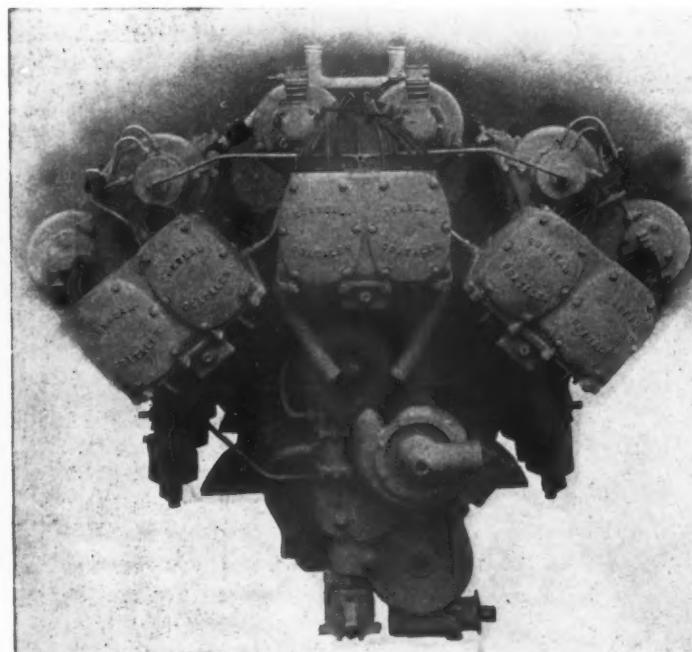
Successful Motor Boat Propeller Diameter, Pitch and Engine Speed

Name of Boat	Size	Type and size of Propeller	Engine Speed	Name of Boat	Size	Type and Size of Propeller	Engine Speed
Syd	30x9x3	Col. Architect 23x26 3-blade	1400	Emma	26x5½	18x30 Hyde	86
Mi Lady	30x5 6"	20x32 3-blade	1300	Mauna Loa	55x5'6" x2'9"	23x24 Columbian	
Quansett	55'	Col. Ailsa Craig 26x32	1000	Hawkeye	26'	19x37 Hyde	
Awawego	38½x8'6"	Col. Rocket 22x22	1000	Vireo II	25x5'4"	16x28 Columbian Architects	
Jay Dee Ess	20x5	3-blade Hyde 18x36	1600	Minnow	35'	26x22 Columbian	
Fame	35x7½	Columbian 3-blade 22x20	1440-1450	Bilking	30'	18x26 Columbian Architects	600
Nancy	30	Col. Architect 18x26	1250	Betty M II	60'x10'x2'9"	24x24 3-blade Col. E	1375
Shadow III	48'10" x12'5" x5'9"	Herreshoff 4-blade 32x47	900	Ginger	25x5	18x28 Columbian	1200
Get There	58x10'6" x24'	23x30 3-blade Columbian	1260-1300	Henry L	36x14	18x24 Columbian	145
Paeronia	7x26	Hyde 20x24	1200	Lura A	32'x7"	32x28 Columbian	500
San Toy III	39x6x2	Architects 22x26 3-blade	1225	30'x5'6"	18x28 Columbian Architects	1150-1200	
Echo III	30'x8' x30"	Columbian Elsa Craig 21x22	1100	Water Bug	28'x6'	18x30	1340
Blue Hen	30x6'8" x4'2"	Ailsa Craig 21x22 3-blade	1200	Runaway Dot	38'x9' x9"3'	22x26 3-blade Col. Architects	1260
Limited	20x6	22" Columbian	1400	Elder	28'x6'	20x25 Col. Ailsa Craig	1085
Polly	29'7" x30"	20x26 Col. Architect 3-blade		Clarimere	30'6"x6'	10x27 Harthan	1450
Raccoon	50x10	Climber 22x24 3-blade		Slymae	37'		14-1500
Rosemary	40x9	Col. Architect 21x28 3-blade		Sea Dog	40'x8'	22x26 Col. Architects	1150
B & B	29'11" x4 1/2"	18x30 Hyde	1100	Marissa	50'x5' x2 1/2"	24x26 Columbian	1200
Hyepus	28x7½	Hyde 18x24	700	Glendale	35'x6' x2'6"	19x30 Col. Arch.	1350
Viking	35x7½	Col. Ailsa Craig 24x24	600	Ishkoohah	32'x6'	20x32 Co. Speed	1100
Watch Your Step	37x9	22x20 Col. Rocket	1175-1225	Elizabeth	30x6	22x22	1200
Nancy C II	35x6'4"	Columbian Architect 28x28	1275	Oregon Kid	20'	18x30 Coolidge	2400
Edamena II	45x10x3'4"	3-blade Columbian 21x28	1200	P. D. Q. VI	24'x6'6"	22x26 Col. Architects	800
Warrior and Wayfarer	45x10x3'4"	3-blade 20½x26	1400	Grisette	60'x8' x30"	22x26 3-blade Hyde	2300
Baby Davis	20x5'3"	Architects 3-blade 18x28	1400	Bogey	39'x7"	19x31 Col. Architects	1400
Sabot	48x10x30	26x24 3-blade Rheig	1400	Pansy II	36x8½x2½	20x30 Hyde	1200
Tonic	26x6'6"	18x27 3-blade Harthan	1225	Virginia	36x6½	20x30 Hyde	1300
Pomander	43x8'9" x2"	22x36 3-blade Columbian	1700	Grumpy	37'1" x9' x2'9"	22x36 Col. Rocket	1115
Maconta	35x4x10	20x28 Hyde	1100	P. S. No. 6	63'x12' x3'3"	30x36 3-blade	950
Gosumore	62	22x27	1150	Islander	51'x12' x3'9"	22x29 3-blade Columbian	615
Wakonda	47x12	24x22	1100	Miss Savannah	25'x5"	18x28 Columbian Architects	1400
Mousier I	35x6	20x30 Columbian Architect	1227	Express II	36'x8' x2"	22x26 3-blade Col. Arch.	
Oklahoma	28x6	20x30 Hyde	1230	Intruder	30'	20x32	1345
Banshee	5x20	18x28 Columbian	1200	Choosum	30'x5'6"	18x27 Hyde	1200-1250
Anita	35x8	24x24 Type "F" Columbian	1500	Grosbeak	39'x9' x34"	22x22 3-blade Col.	1300
Wawona	61x13'6"	2-blade 26D 22P Kennedy & Sons	920	Speeder II	35'x6'6"	20x34 Ailsa Craig	1450
Elizabeth II	28x6	18x24 Columbian Architect	1535	Hasty	32'x6'	17x27 Columbia	1100
Romany	50x10	25x25 3-blade Columbian	1225	Inia III	26'x6' x28"	18x26 3-blade Hyde	1250
Nymph	35x7'4" x30"	20x26 3-blade Columbian	1280	Loleta	57'9" x11'6x3	24x24 Hyde	1000
Empire	35x6'6" x2	20x24 3-blade Hyde	1000	Texas	28'x6'6"	16x30 Columbian	1175
Virginian	30x6'4"	19x29 Columbian Architect	1500	Greyhound	40'	22x26 Col. Rocket	1280
Swannanoa	38x7'6"	20x30	1040	Reths	38'x10'9	22x22 Columbian	1300
Mariedee	49x13'6"	21x28 Twin	700	Lydia	40x9x3	22x26	1100
	28'	17x26 Columbian Architect	1500	Wana II	40x7	22x28 Col. Arch.	1050
	40'x9'	22x36 Columbian Rocket			65'	26x26 Type "C" Coolidge	800
Cenuscan II	40'	22x26 Columbian Architect	1152	Quo Vadis	50'6" x8'6" x3'6"	26x38 3-blade Columbian	1000
Kingfisher	60'x10'10" x3'	23x24 3-blade Columbian	1050-1100	H-2	30x6'4" x14	19x30 Columbian	1240-1255
Marguerite II	40"	22x26 Columbian	1200	Cossack	64x9'6" x3'3"	22x30 Columbia	1250
Spendthrift	31'6" x6'9"	20x20 3-blade	1425	Alma	30'x6' x13"	19x30 3-blade Col. Arch.	
Margurt	38'x9'6" x20'	24x34 3-blade Columbian	530	Rondenella	35x6	20x33	
Flashlight	40'x9'3"	22x26	1200	Cahetis	25x52	28x33 3-blade 1400	1400
Aurilla Hart II	35'	28x30 2-blade Columbian	1600	Reba	52x5x9	18x26 Hyde	900
Mouser II	43x7'6" x28"	26x36 Type I Columbian	1500	Venetian Maid	60x10x3	24x27 3-blade C. N. A.	1200
The Whee	40x9x36	24x24 3-blade	1050	P. S. S.	72'	25'x10'	750
Countess	40x8'6" x2'5"	21x28 3-blade Col. Architect	1480	Joffre	35x6'6"	23x23 Col. Rocket	1400
Dispatch	45'	26x24 Columbia	1200	Agnes B	58'	22x24 Ailsa Craig	1460
Sun Dog	36x9	20x22 Hyde	1125	Marian	55x10x3	32x33 P. Johnson	850
Aleene	26'	18x20 3-blade	1650	BAB	36x12x28	34x34 3-blade Hyde Surface	600
Redrah	35x8'3" x30	3-blade Columbia	250-550	Baby Marold	25x7x2	24x40 3-blade	1200
Toxaway	26x6	18x26 Columbia	1160	Marold Jr.	35'	18x40 Hyde	2000
Helianthus	64x13'6"	36" 4-blade	1350	Warebeth III	35x6'7" x52"	18x30 3-blade Hyde	1226
Drowse		18x26 Col. Architect	1200	Happy Days	35'	20x30 Col. Arch.	1375
Bobolink	38x6	20x30 Hyde	1410	Boomerang	53x11'6" x2'6"	23x20 3-blade	1450
Roatter	30x6	20x32 Architects	1400	Elliott	30x5	20x28 Type E Columbian	750
Verhoo		22x23 3-blade G. Columbian		Boola	32x6'5" x2'6"	18x26 Columbian	
Silhouette	30'6" x8'2'3"	18x22 3-blade Columbian I	1400	Caddy II	40x8'9" x30"	23x32 3-blade	1360

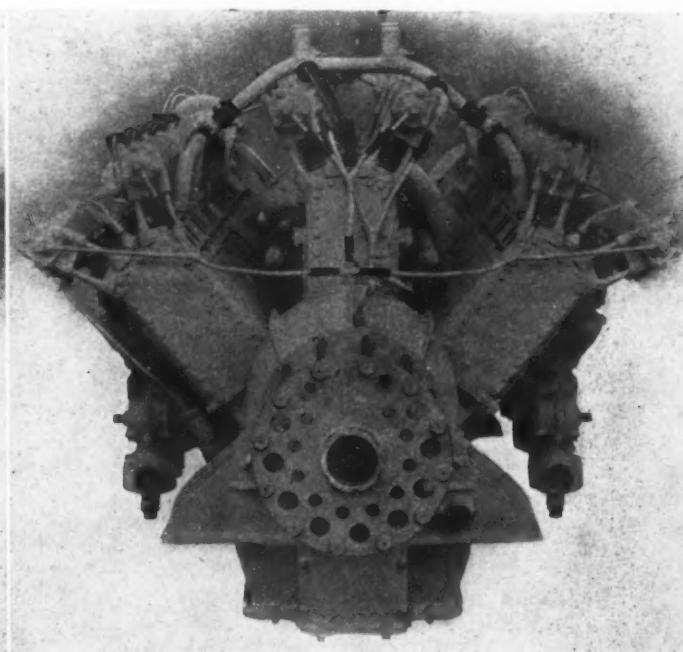
Sunbeam-Coatalen Eighteen-Cylinder Airplane Engine



Side view of 475 brake hp., eighteen-cylinder, water-cooled overhead-valve Sunbeam-Coatalen aircraft engine, Broad Arrow form. In this arrangement three rows, each of six cylinders, are fitted on a crankcase, which is a one-piece casting with the nose piece. There are six carburetors on this machine, each serving a block of three cylinders.



Magneto end view of 475 brake hp., eighteen-cylinder, water-cooled overhead-valve Sunbeam-Coatalen aircraft engine of the Broad Arrow form. In this model six magnetos are contained in patent water-tight casings and furnish two independent sparks through the medium of two independent K.L.G. plugs. Light weight requirements render ignition a problem



Propeller end view of the Broad Arrow type for 475 brake hp., eighteen-cylinder, water-cooled, overhead-valve Sunbeam-Coatalen aircraft engine. In this form three rows, each of six cylinders, are set on a common crankcase, the connecting-rods of the pistons in the side sets of cylinders being linked to the master connecting-rod of the center set

Sunbeam-Coatalen Aircraft Engines

Prominent British Factory Turns Out Engines for Airplanes in Six, Twelve and Eighteen Cylinder Types

AIRPLANE engines have constantly grown in power since the beginning of the war, and cylinder numbers have increased until now the V-type engine has been succeeded by the W-type. An engine with no less than eighteen cylinders, and developing 475 hp., is now being built by the Sunbeam Co. of Wolverhampton, England, from designs of the company's engineer, Louis Coatalen. It supplements a six-cylinder and a twelve-cylinder design previously manufactured.

In all the types of engines the crankcase and nose piece are cast in one, resulting in a saving in weight and proportionately greater rigidity. Another point concerns the absence of flywheels. The engine base is a dry sump in combination with a compound pump at the bottom. Every example of this series of Sunbeam-Coatalen aircraft engines has overhead valves—two inlet and two exhaust valves per cylinder—with the spark plug set in practically the ideal position. The series of views illustrates the vertical, narrow type of engine; the V-form; and the broad arrow type wherein three rows, each of six cylinders, are set on a common crankcase. In this water-cooled series the gasoline and oil consumption are notably low, as is the weight per horsepower, particularly in face of the handicap under which British manufacturers have to work nowadays owing to the relative unreliability of magnetos.

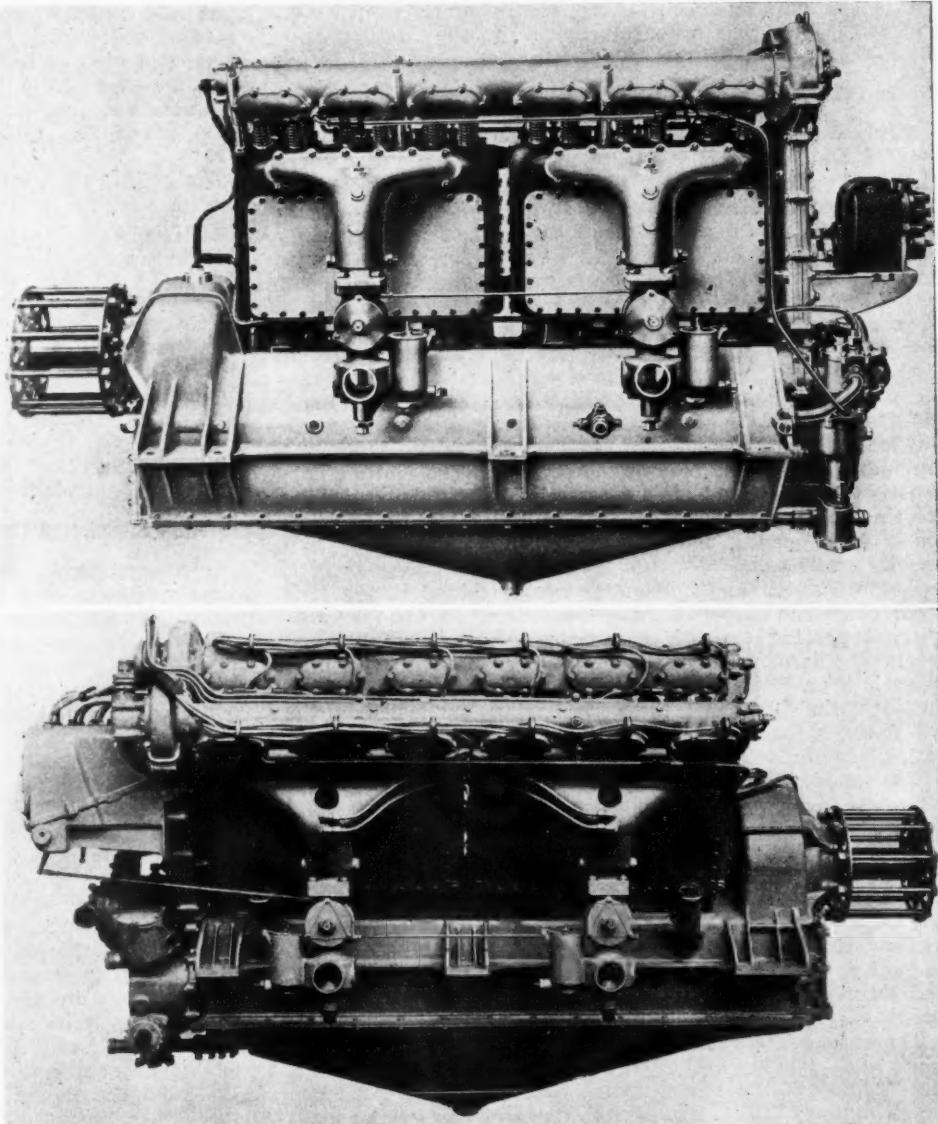
Half Dozen Magnets

Thus, in regard to the eighteen-cylinder overhead valve Sunbeam-Coatalen aircraft engine of 475 brake hp., there are no fewer than half a dozen magnetos. Each magneto is inclosed. Two sparks are furnished to each cylinder from independent magnetos. On this engine there are also no fewer than six carburetors. Shortness of crankshaft, and therefore of engine length, and absence of vibration are achieved by the linking of the connecting-rods. Those concerned with three cylinders in the broad arrow formation work on one crankpin, the outer rods being linked to the central master one. In consequence of this arrangement, the piston travel in the case of the central row of cylinders is 160 mm., while the stroke of the pistons of the cylinders set on either side is in each case 168 mm. Inasmuch as each set of six cylinders is completely balanced in itself, this difference in stroke does not affect the balance of the engine as a whole.

The duplicate ignition scheme also applies to the twelve-cylinder

350 brake hp. Sunbeam-Coatalen overhead valve aircraft engine type. It is distinguishable, incidentally, by the passage formed through the center of each induction pipe for the sparking plug in the center cylinder of each block of three. In this, as in the eighteen-cylinder and the six-cylinder types, there are two camshafts for each set of cylinders. These camshafts are lubricated by low pressure and are operated through a train of inclosed spur wheels at the magneto end of the machine.

The six-cylinder, 170 brake-hp. vertical type employs the same general principles, including the detail that each carburetor serves gas to a group of three cylinders only. It will be observed that this engine presents notably little head resistance, being, suitable for multi-engined aircraft.



Above—Side view of the 170 brake hp. six-cylinder overhead-valve Sunbeam-Coatalen aircraft engine for multi-engine machines. Lower—Side view of the 350 brake hp. twelve-cylinder overhead valve Sunbeam-Coatalen aircraft engine of V-form. All photographs on these pages have been passed by the censor.

Woods Dual Power Analyzed

Simplicity of Control an Important Feature—Special High-Speed 2 3/4 by 4-in. Engine Used in Connection with 48-Volt, 60-Amp. Compound-Wound Dynamotor and 24-Cell Battery,

AUTOMOBILES propelled by a combination gasoline and electric power plant are not a new thing, and some years ago a special committee of the Metropolitan section of the Society of Automobile Engineers made a report on the history of the gas-electric car. There appears, however, to be a very wide range of possibilities in the arrangement of the control of such vehicles, and the problem is one that taxes the ingenuity of designers.

Evidently the control must be as simple to handle as that of a gasoline car, yet it must enable the driver to employ both the engine and the electric power plant to best advantage under all conditions of driving. A most interesting arrangement of the control is found on the new Woods Dual Power car, manufactured by the Woods Motor Vehicle Co., Chicago, which was recently shown for the first time in New York.

Power Plant Specifications

The power plant consists of a four-cylinder Continental 2 3/4 by 4-in. gasoline engine, a magnetic clutch of Cutler-Hammer make, a General Electric compound-wound dynamotor rated at 48 volts and 60 amp., and a special Exide plate battery of 24 cells, with a capacity of 115 amp. hr., based on a 5-hr. discharge rate. The engine is of special design, with three-bearing crankshaft, light reciprocating parts, and adapted to high-speed operation. Lubrication is by pump feed direct to the main bearings and by spray to the other parts. Gasoline is carried in a seamless tank of 8-gal. capacity, secured to the forward side of the dashboard. Ignition is by the Atwater Kent K-2 system, with automatic timing control. Current for ignition, for which an insignificant amount is required, is taken from the three end cells of one tray of the battery. The ignition current is turned on and off by means of a lock switch on the steering post. Thermo-syphon circulation of the cooling water is employed, the water being circulated through a tubular radiator.

Engine, clutch and dynamotor are combined into a unit from which the power is transmitted direct to the rear axle without passing through a variable gear. Two universal joints are incorporated in the propeller shaft. The final drive is by a Bausch undermounted worm gear having a reduction ratio of 8.25 to 1, the worm having four leads and the wheel thirty-three teeth. While the engine has a formula rating of only 12.5 hp., it develops 25 hp. at 2600 r.p.m.

The car is started as an electric vehicle, with the engine at rest. As the electric machine is of the compound wound type, the starting characteristics are somewhat different from those of the ordinary electric vehicle, yet it starts off absolutely without jar. A starting resistance is first connected in series with the motor, and this is automatically cut out of circuit after the car has attained a certain speed. The starting controller, or the control panel as it is called, and the reversing switch are located under the driver's seat, and there is a shunt field control rheostat under the foot-board.

The magnetic clutch is of the plate variety, and is combined with the flywheel. An electric coil is set into a recess formed in the flywheel rim, and when energized the clutch plate is drawn against the flywheel rim by the magnetic force produced. The clutch plate is faced with asbestos fabric, and the clutch therefore cannot be injured by slipping.

There are two finger levers on the steering wheel. The outer of these controls the field rheostat. When this lever is

at the top of the wheel, all of the field resistance is in circuit, and the car runs at maximum speed. The inner finger lever controls the clutch circuit and the throttle. When the car is standing, both finger levers are near the bottom of the sector, and moving these levers forward has the effect, while the car is in operation, of increasing the speed. In this respect the control is similar to that of a gasoline car. The first slight movement of the inner finger lever opens the throttle; continued movement of this lever closes the circuit of the magnetic clutch, which operates on full battery voltage, except when the car is being reversed, when the clutch is free. The throttle valve continues to open until the top-most position of the finger lever is reached. That the car runs at maximum speed when all of the resistance of the rheostat is in circuit is due to the fact that the field is then weak, and even at high speed the voltage generated will be less than that of the battery, hence the electric power plant will not be a drag on the engine, but, on the contrary, develop power and assist the gasoline engine to propel the car.

The main switch in the control panel, which connects the electric machine to the battery, is not operated directly or mechanically by the driver, but through the intermediary of a solenoid. For the sake of absolute safety, so that the power can be shut off under all circumstances, there are three breaks in the circuit of this solenoid. In starting the car, this circuit is closed by the first motion of the outer finger lever, which acts on the specially-designed switch on top of the field rheostat under the footboard. Another switch in the solenoid circuit is connected with the right-hand pedal pad. This is normally closed, but can be opened by pressing on the heel piece of the pad. Finally the circuit is controlled by the lock switch on the steering column, which also controls the ignition circuit.

Starting Resistance Cut Out Automatically

An interesting feature is incorporated in the control panel whereby the starting resistance is cut out of circuit automatically at the proper time. In addition to the main switch, there is a secondary switch which is located under the main switch. The purpose of this secondary switch is to short-circuit the starting resistance when the vehicle has attained such a speed and the conditions of traction resistance are such that the armature current has dropped down to about 175 amp. In order to accomplish this, the secondary switch is operated by means of a differential electro magnet. It is held in the open position by a series wound magnet through which the main current of the motor passes, and it is closed by a shunt-wound magnet. At the moment of starting from rest, the motor draws a heavy current from the battery, which may be as high as 400 amp. This naturally makes the series magnet very strong, and the secondary switch is held firmly in the open position, although the shunt-wound magnet tends to close it. As the vehicle picks up speed the current drawn by the electric motor quickly decreases in value, and as it passes the 175-amp. mark the shunt-wound magnet overpowers the series magnet, and the secondary switch closes, cutting out the starting resistance.

This balance in magnets, and the amount of resistance, have been determined for the best operation under driving conditions ordinarily met. In order to provide great power under adverse conditions, as, for instance, in a start on a hill, through sand, mud, etc., a kick-in button is placed directly behind the driver's right heel. This closes the secondary switch instantly, without waiting for automatic ac-

tion, and provides greater power than could well be used normally. This type of switch has been used for a number of years for starting electric elevators, and has merely the added feature of a foot control.

Adjacent to the main and secondary switches is located a reversing switch, by means of which the armature leads of the generator are reversed, so as to permit of backing the car by electric power only. There is an interlocking mechanism between the right-hand control pedal and the reverse switch, so arranged that the reversing switch cannot be operated unless the right-hand control pedal is pressed forward until the brake is applied. Therefore, to reverse, the right-hand pedal is first pushed forward, then the reverse lever is depressed with the left foot, and then the right-hand pedal is allowed to come back, whereupon the car begins to move slowly backward, depending, of course, upon the position of the outer finger lever controlling the field rheostat.

Method of Starting Car

The method of starting the car is as follows: First the lock switch on the steering column is turned to the "on" position, whereby the main switch operating solenoid circuit is closed at this point and the ignition current turned on. Next the outer finger lever is moved a short distance up on the steering wheel sector, whereby the circuit of the main switch solenoid is completed. The car then starts under electric power. To start up the engine it is only necessary to slightly move the inner finger lever up or forward. The very first motion of this lever opens the throttle slightly, and continued motion of the lever closes the clutch circuit and causes the clutch to take hold and the engine to start up. The energy required for starting the engine is partly withdrawn from the car, and a slight slowing down is noticeable when the clutch takes hold. Further motion of the inner finger lever opens the throttle wider and slightly increases the speed of the car. A more pronounced effect on the speed of the car is produced by the outer finger lever, which, as it is advanced, cuts resistance into the field circuit and therefore either reduces the drag due to battery charging or increases the assistance given the engine by the electric motor, as the case may be. The inner finger lever, of course, controls the power developed by the engine.

It is also possible to run the car on the gasoline engine alone, with the electric machine entirely disconnected from the battery, and, therefore, neither generating charging current nor taking current from the battery. To this end it is only necessary to press down on the heel piece of the right-hand pedal, when the main switch will be opened and the battery cut off. The armature of the dynamotor is, of course, turning at the same speed as the engine, and current for the shunt field and for the magnetic clutch, which latter is connected in parallel with the shunt field, is still being generated.

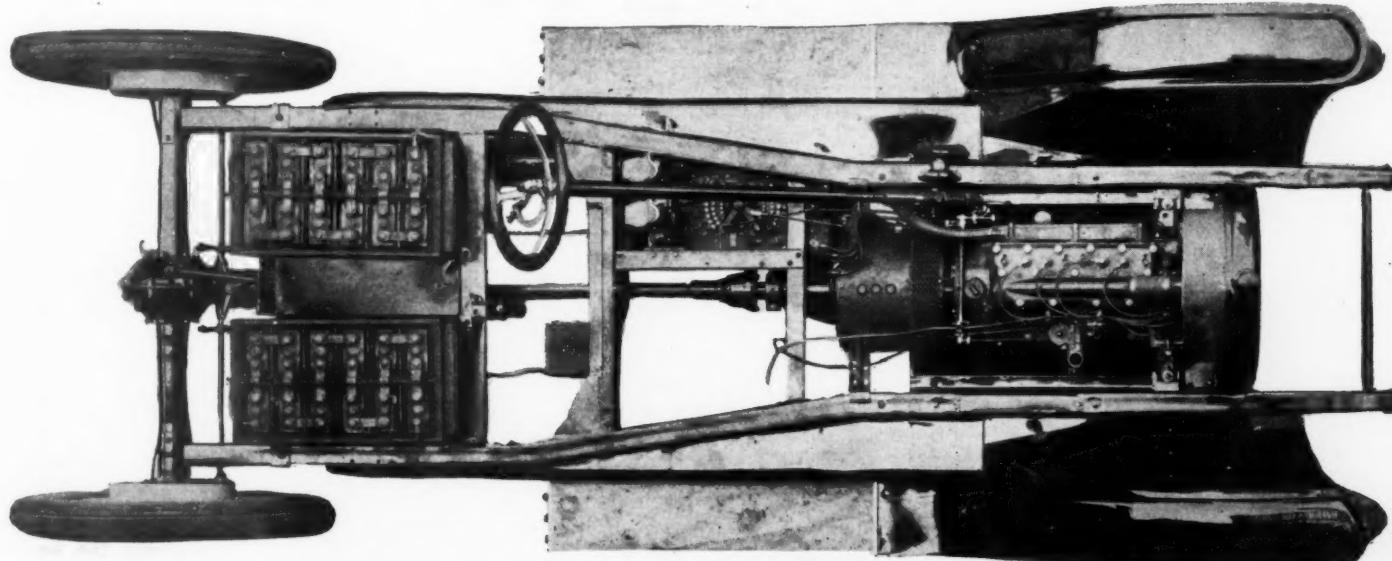
ated. When the speed of the engine and generator drops below a certain value, the generated voltage drops too low to hold the clutch in, and the car will then stop. The speed at which the clutch opens is somewhat above the minimum speed of the engine and the latter will keep on running, though it is then throttled down so much and it is balanced so nicely that its running is hardly perceptible.

Left Pedal for Emergencies

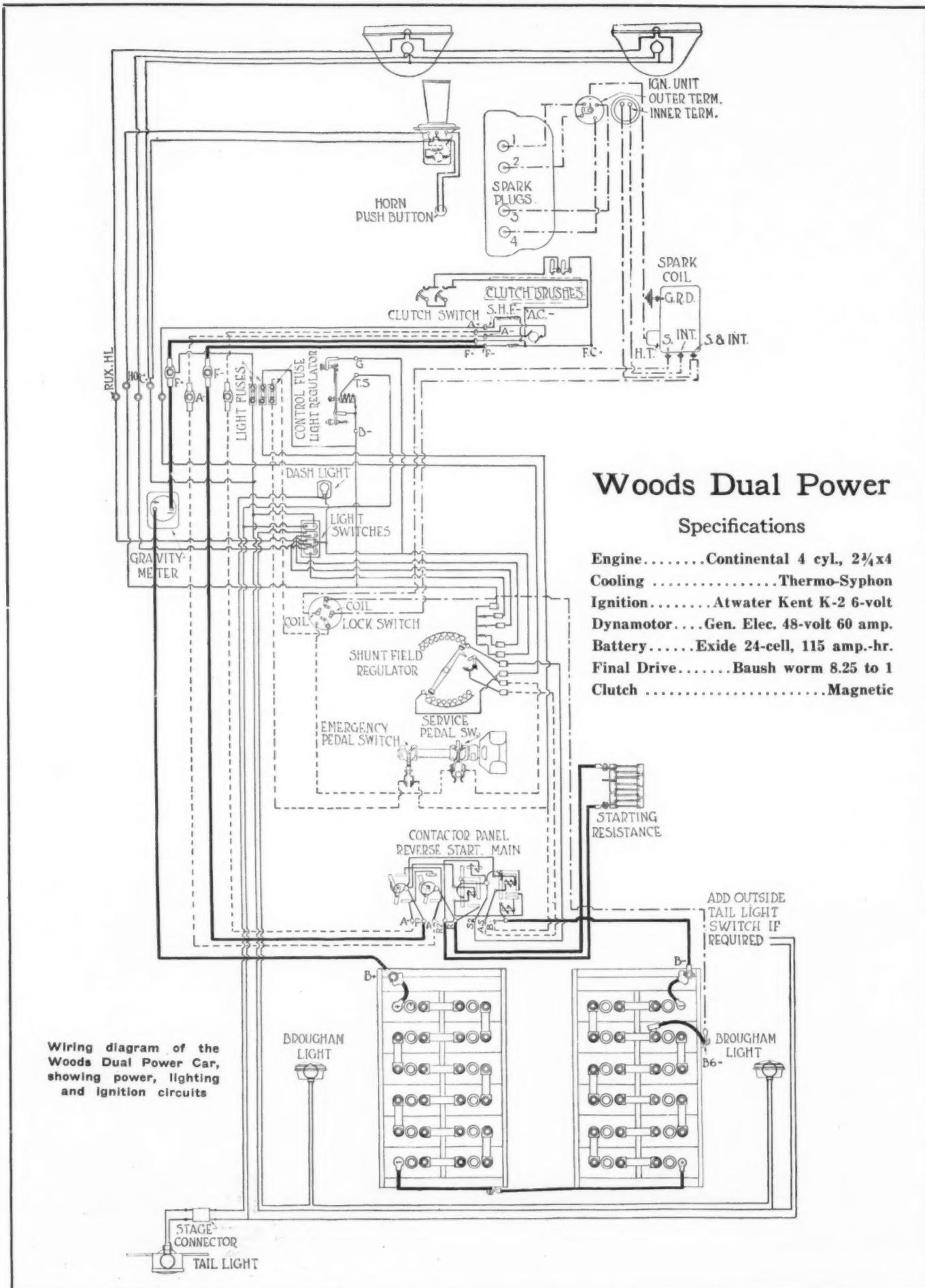
The pedal on the left is an emergency pedal and serves to open the main switch solenoid circuit, the ignition circuit, and the armature circuit in the reverse switch, and to apply the mechanical brake. This pedal, like the right-hand one, is provided with a swiveled pad, which in this instance is used to operate a ratchet to set the mechanical brake by.

One of the effects of using a shunt-wound dynamotor for the operation of the car is that a so-called dynamic braking action is obtained automatically. The voltages or electric pressures of the dynamotor and the battery are constantly balanced against each other. That of the battery is substantially constant, while the voltage of the generator goes up and down with the engine speed and can also be regulated by means of the field rheostat. If the voltage of the battery is greater than that of the dynamotor, the latter acts as a motor and assists the gasoline engine in propelling the car. On the other hand, if the voltage of the battery is less than that of the dynamotor the latter acts as a generator and the battery may be considered to produce a certain braking effect. This braking effect can be increased by cutting out resistance in the field circuit. This is done by means of the right-hand pedal, which when moved a slight distance forward, produces dynamic braking, and when pushed forward all the way applies the mechanical brake. A very advantageous feature of the dynamic braking action is that the energy stored up in the car, instead of being wasted in heating and wearing the brake bands, is transformed into electric energy and stored in the battery. This is sometimes referred to as recuperative action. Dynamic braking is a convenience and an economy in descending long grades, when the outer finger lever may be set to hold back the car speed as desired, the use of the mechanical brake being unnecessary.

Charge and discharge currents of the battery are indicated by a so-called center zero instrument on the dashboard, which is combined with a gravity meter showing the state of charge of the battery. The ammeter has a discharge scale up to 120 amp. and a charge scale up to 60 amp. The gravity meter is really an ampere-hour meter which is calibrated to indicate the specific gravity of the battery, which latter rises and falls with the charge in the battery. The dial of this instrument is divided into three zones, the two end zones, referred to as danger zones, being red, and the center zone, referred to as the normal operating zone, white.



Plan view of Woods Dual Power car, showing compact grouping of gasoline engine, electric dynamotor and other units



Owners are instructed to so operate their cars as to keep the battery in a state of charge corresponding to the central, normal zone. The red zone on the left, which is the discharged or sulphating zone, extends from about 1.160 to 1.190 specific gravity, and the fully charged or gassing zone on the right extends from about 1.260 to 1.280 specific gravity.

One of the advantages of the dual power system is that it permits of comparatively rapid acceleration with even a small engine. As soon as the engine is started, both the gasoline engine and the electric machine pull together to accelerate the car, and inasmuch as the torque of the electric motor at low speeds is considerable, the accelerating power of the two motors combined is great.

Another feature that should make the dual power car attractive to purchasers is that the engine is non-stalling. This, of course, applies only when both the gasoline engine and electric machine are working, which they really always are. Running on the gasoline engine alone is a possibility, but has no practical advantages. High fuel economy is claimed on the ground that the engine is always running closer to its full capacity than in a gasoline car, consequently the effective compression pressure and the fuel economy are higher. There is, of course, a loss on that part of the power which is converted to electric power, but this is only a fraction of that generated by the engine.

The battery is arranged in two trays which are located under the seat and the rear hood. They can be easily withdrawn from the vehicle by merely lifting the rear hood and pulling them out.

Sides of Inverted U Section

The chassis has pressed steel side members of inverted U section instead of the usual channel section, and the members of the frame are welded together by the oxy-acetylene process. The front springs are half elliptic and the rear springs of the cantilever type. The front axle is a one-piece drop forging of I section. The rear axle is of the three-quarter floating type and comprises axle tubes of swedged steel tubing which are flanged on the inner end and bolted to the driving gear housing. Internal expanding brakes act on drums on the rear wheels. The shafts for operating these brakes are mounted in self-lubricating bearings in brackets secured to the axle housing.

The wheelbase is 124 in. and the tread is standard. Artillery wood wheels are fitted, carrying 35 by 4½-in. cord tires.

The electric lights are operated from the main battery and, therefore, are of the high voltage type. Sixty-volt bulbs are used in the headlights, and 30-volt bulbs connected in series in the dimmer lights. A relay is mounted in a dash compartment and automatically reduces the lamp voltage when it exceeds 52 volts, as will sometimes happen under conditions of heavy charging. In this same compartment on the dash are located the fuse blocks, and a set of extra fuses in a holder convenient to the fuse block.

The body is of aluminum panel construction and of coupé design. It has very wide doors, the glass windows of which may be lowered by means of a handy crank mechanism. The front and rear windows may also be opened.

The car is trimmed in black and white whip cord, though leather trimming is optional. It is painted either blue or green, with the wheels in light straw color. The equipment includes a combined gravity meter and ammeter, a speedometer with trip odometer attachment, a gasoline gage and a robe rail. The light switches are mounted on the steering post and the warning signal switch is on top of the steering wheel. A compartment under the rear hood affords space for an extra tire casing or demountable rim, while the tire pump, jack, and tools are carried in a compartment back of the driver. The headlights are equipped with auxiliary bulbs for dimming as already mentioned. A special adjustable rain vision windshield and a rear vision mirror complete the standard equipment. A speed of 20 m.p.h. is obtained running on the battery alone, and about 35 m.p.h. when the engine is operating.

As described, the car sells for \$2,950. Extra equipment is offered at the following rates: Wire wheels, \$25; slip covers, \$25; demountable rims, \$25.

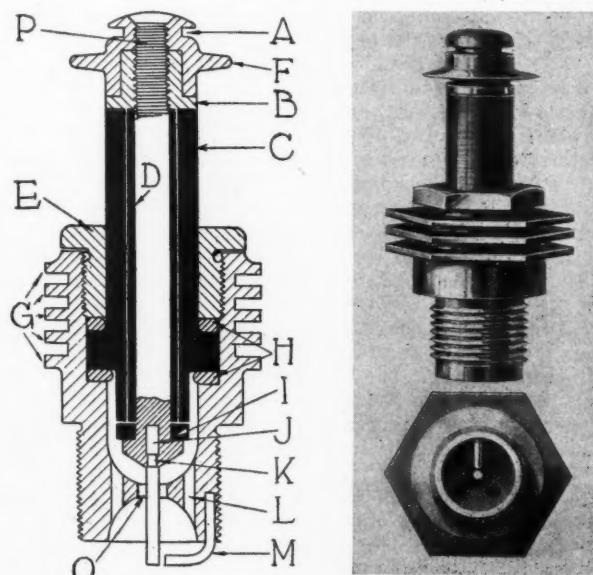
Pittsfield Brings Out Airplane Type Spark Plug

AIRPLANE work calls for special construction of spark plugs, owing to the high compression used in the engines and the fact that they are operated on open throttle practically all the time, thus causing a great deal of heat to be developed. The Pittsfield Spark Coil Co., Pittsfield, Mass., has just brought out the airplane type plug illustrated herewith. The core C is built up of mica washers, and has square shoulders. As mica washers of different sizes may be used, and accurate machining, such as is necessary with conical clamping surfaces, is not required, the plug can be produced economically. The square shoulders of the core afford two gasket seats, and when the core is clamped in the shell by means of check nut E, it is accurately centered and a tight joint is formed. This construction also makes a shorter plug than where conical fits are used, thus improving the heat radiation through the stem. The lower end of the shell is provided with a baffle plate O, which tends to keep the oil away from the mica. There are perforations L in this baffle plate to prevent burnt gases being pocketed behind the baffle plate and preigniting the new charge. This construction also brings the firing point out into the firing chamber of the engine, and has all the other advantages of a closed end plug. The stem P is made of brass or copper, on account of their superior heat conductivity, and the electrode J is swedged in to the bottom of the stem, as shown at K, in a secure manner.

The shell is finned, as shown at G, to provide greater heat radiating surface. There is also a fin F at the top of the stem, to increase the radiation of heat from the stem and electrode. The top of this finned portion is slightly countersunk, and the stem is riveted into same, thereby reducing the possibility of leakage past the threads on the stem. This finned portion is necked at A to take a slip terminal.

In building up the core a small section of washers I is built up before the mica insulating tube D is placed on. This construction gives a better support to section I. Baffle plate O is bored out to allow the electrode J to pass through, and the clearance between baffle plate and electrode is made larger than the width of the gap between the firing points, so that there is no danger of the spark jumping from the electrode to the baffle plate.

This plug will be furnished either with or without the finned portion, to meet individual requirements. The manufacturers lay special stress upon the simplicity of construction and upon the method of clamping, which is claimed to make the plug absolutely gastight.



Pittsfield airplane type spark plug which has mica insulation throughout. Note ribbed body

4,219,246 Automobiles in World

Census of Cars and Trucks By N. A. M. Indicates That United States Had 84 Per Cent on Jan. 1, 1917—Room for 51,981,967 More Motor Vehicles

By Donald McLeod Lay

SUMMARY BY PRINCIPAL GEOGRAPHICAL DIVISIONS

Division	Cars in Use Jan. 1, 1917 with U. S. A.	Potential Market Out- side U. S. A.
United States	3,500,000	3,500,000
Canada and other North America	118,086	295,413
Mexico and Central America	5,744	710,100
South America	39,188	1,900,000
West Indies	11,394	301,000
Europe	437,558	15,583,300
Asia	27,758	28,876,300
Africa	24,178	4,513,700
Australasia and Oceania	55,340	521,300
Totals	4,219,246	56,201,213
		3,617,570

THREE were 4,219,246 automobiles and motor trucks in use throughout the world on Jan. 1, 1917, according to an automobile census of all countries made by the National Assn. of Manufacturers. Of these, 3,541,738, or 84 per cent, were in the United States, as recorded in the annual statistical review of **THE AUTOMOBILE**. Basing possible markets in foreign lands on the same population ratio as obtained in this country at the beginning of this year, the total field for motor vehicles in the world is 56,201,213, or 51,981,967 more than were in use on Jan. 1. The information compiled by the association follows:

One automobile to every thirty people; every sixth family able to ride in its own automobile is the status of the United States at the beginning of 1917 in the use of self-propelled passenger vehicles, based on the registration on Jan. 1, 1917, of 3,500,000 automobiles for 103,000,000 of population—if evenly distributed.

If the people of the United States can encourage the development of the automobile industry to this extent, to what degree may the manufacturer of this vehicle look to the peoples of other lands for support? An attempt at an approximation to an answer to this question is made herewith.

In the third column of the tables on the opposite page is given from the best sources available an estimate of the number of automobiles in use throughout the world at a given time—the beginning of the present year, 1917. In the last column the endeavor has been to indicate what reasonably may be considered the potential market or automobile buying possibilities of all countries under normal commercial conditions, or conditions prevailing before the great war. As far as practicable the figures have been confined to passenger cars.

In estimating the number of cars in use where registration or other official data were not available, the figures are based on production and import and export statistics and the arbitrary assumption that the life of a car is from 5 to 6 years.

The potential market is predicated in part on the possibilities of sale were the same intensive selling campaign conducted in all countries and the same facilities for buying and at the same prices as prevail in the United States.

On Jan. 1, 1917, the number of automobiles and motor trucks registered in the United States was 3,541,738 or one for every twenty-nine persons in the country, accepting our population as being in round numbers 103,000,000. Records are not available from all States showing separately the number of commercial cars registered, but making a fair allowance for these (which are still a small percentage of the whole), would leave enough passenger vehicles to allow one to every thirty-one of the people.

The tables have been compiled from many sources of information: American and foreign government statistics, trade journals, consular reports, communication with corre-

spondents abroad, interviews with business men of many countries; in fact, every available medium has been diligently studied for a long time in order to bring the results as near to the date, Jan. 1, 1917, arbitrarily taken, as practicable. But it must be manifest to every economist, statistician, manufacturer, and incidental student, that to get from all the countries and subdivisions as well as the colonies of every land in the world, precise statements of the number of pleasure cars in actual use on one and the same day, is—humanly speaking—an impossibility.

Possibilities Compared with Actualities

The column headed Full Parity with U. S. A. contains figures that are derived by working out this proportion: as the population of the United States of America in December, 1916 (103,000,000), is to the population of the given country, taken from the latest census or official estimate, so is the number of cars in use in the United States on Jan. 1, 1917 (in round numbers 3,500,000), to the number that would be in use in the given country were the distribution of cars on exactly the same parity: that is, a car to every thirty of population.

The total, over 56,000,000 cars, is, of course, in the realm of imagination. To give Asia—wherein natural and economic conditions combine to reduce greatly the present buying capacity of the people as compared with those of citizens of the United States—the same proportion as this country would be called a wild dream. The figures are given as being reasonably sure to interest those who are concerned in the manufacture of motor vehicles. After all, is such an estimate really such a ridiculous figment of a wild imagination as it may seem? Who in the United States would have done otherwise than put the same stamp of condemnation upon the man that, in A. D. 1900, had prophesied an automobile census for this country of over three and a half million cars in 1917? The word "impossible" should be used very cautiously in application to any branch of commerce or manufacture—even that which seems to be actually insignificant—when discussing its potentialities.

World's Proximate Capacity

In the effort to arrive at the potential purchasing capacity of a given country, absolutely arbitrary ratios have been used. For example: for Canada, it is assumed that the financial ability of the people, physical condition of the country and economic requirements of the inhabitants enable them, and eventually will induce or require them, to utilize at least one car to every two in the States; in the crowded provinces of central China, in the western districts of that land and in Tibet, the ratio is one to 10,000, while in far away New Zealand conditions may fairly be considered to warrant the buying of automobiles to a larger degree than even in this country.

Bases of Potential Capacity Estimate

When attempting to fix this ratio of potential purchasing capacity, a number of factors have been carefully considered. The physical nature: to assume that Tibet, or Northern Siberia, or the African Sahara, or Patagonia is likely to be a potential market for automobiles, is extremely hazardous, to say the least. Then the physical development of the country has been measured very closely: where there are roads over which the automobile can travel readily, or if it is feasible to

build such roads, naturally the potential capacity is greater than in lands traversed by the Himalayas or the Andes, or cut up and impeded by deltas like those of the Amazon, or the Yellow River, China. The social development of the people is another crucial test. It is manifestly absurd to think of automobile development among the Samoyeds of Central and Northern Siberia, the natives of Arabia, or the Congo negroes, upon the same scale as in France. Purchasing power finally comes to be measured by the individual and community purses. There are, in the United States, easily 10,000 people who can buy and run an automobile to one who can do so in China. This disparity is probably the greatest, yet it will be readily discernible in other parts of the world, in differing degrees, by all careful students. As the cheapest make of cars are improved and their prices still further lowered, it is needless to say their use in territories which are now reasonably styled "impossible" will expand rapidly. Then, too, the second-hand and third-hand automobile has not yet found its

way into remote districts abroad; when it does so, as it is sure to do, the potential purchasing capacity of many countries now thought negligible will be well worth considering.

The investigations upon which this report and these tables are based, brought out conspicuously the fact that already the automobile has established itself in lands which would not have been considered a very few years ago. It is probably surprising to many of those who are actually in the business, to find Iceland credited with ten cars, the Congo with 100; the Kameruns with ten, Eritrea with four, Turkish possessions in Asia with (probably) 100, the islands of the Pacific with nearly 150. These are merely a few of the straws which show how the automobile wind is blowing.

The two columns headed Estimated Number of Cars Jan. 1, 1917, and Potential Market should not be considered as being results of mathematical precision: they are chiefly estimates and as such should be considered suggestive, not accurately informative.

Automobile Census of World, Including Population and Possible Market

NORTH AMERICA					
Country	Population	Estimated Number of Cars, Jan. 1, 1917	Full Parity with U. S. A.	Potential Market	
British:					
Bermudas	21,000	713	100		
Canada	8,500,000	118,000	290,000	200,000	
Newfoundland	52,000	86	1,800	300	
Danish:					
Greenland	85,000	.....	2,900	25	
Mexico	15,502,000	4,500	527,000	25,000	
United States	103,000,000	3,500,000	3,500,000	.....
CENTRAL AMERICA					
British Honduras	41,000	13	1,400	35	
Costa Rica	420,000	150	14,000	1,000	
Guatemala	2,119,165	250	72,000	2,000	
Honduras	566,017	80	20,000	200	
Nicaragua	600,000	20	20,000	100	
Panama	341,090	106	11,600	350	
Panama Canal Zone	62,000	500	2,100	500	
Salvador	1,226,000	125	42,000	600	
SOUTH AMERICA					
Argentina	9,000,000	21,000	306,000	100,000	
Bolivia	2,267,935	95	80,000	500	
Brazil	24,000,000	11,000	816,000	100,000	
British:					
Guiana	309,938	178	10,500	500	
Chile	3,600,000	2,600	122,000	12,000	
Colombia	5,472,604	600	186,000	6,000	
Dutch:					
Guiana (Surinam)	86,000	50	3,000	100	
Ecuador	1,500,000	250	51,000	800	
French:					
Guiana	50,000	15	1,600	50	
Paraguay	850,000	35	29,000	1,000	
Peru	4,500,000	500	153,000	3,000	
Uruguay	1,400,000	1,565	48,000	12,000	
Venezuela	2,764,241	1,300	94,000	4,000	
WEST INDIES					
American:					
Porto Rico	1,185,000	2,362	40,000	6,000	
British:					
Barbados	176,000	125	6,000	500	
Jamaica	883,000	800	30,000	2,000	
Trinidad	358,000	325	12,000	1,000	
Other	359,000	175	12,000	500	
Cuba	2,467,883	7,000	84,000	15,000	
Dominican Republic	710,000	200	24,000	1,000	
Dutch:					
Curacao	33,400	100	11,000	200	
French	412,700	250	14,000	500	
Haiti	2,000,000	57	68,000	500	
EUROPE*					
Austria-Hungary	49,882,331	16,356	1,695,000	120,000	
Azores—Madeira Islands	412,390	100	14,000	200	
Belgium	7,571,387	14,708	277,000	50,000	
Bulgaria	4,752,997	1,000	162,000	6,000	
Denmark	2,775,075	4,000	94,000	13,000	
Iceland	85,188	10	2,900	100	
France	39,601,509	96,434	1,346,000	450,000	
Germany	64,925,993	75,839	2,206,000	600,000	
Gibraltar and Malta	246,570	45	8,400	60	
Greece	4,821,300	500	164,000	2,500	
Italy	36,120,118	22,531	1,228,000	100,000	
Netherlands, The	6,339,705	7,000	215,000	30,000	
Norway	2,391,782	1,484	81,000	3,000	
Portugal	5,545,595	2,888	188,000	9,000	
Rumania	7,508,099	500	255,000	10,000	
Russia (in Europe)	146,686,600	27,913	5,000,000	250,000	
Serbia	1,503,511	.....	51,000	1,000	
Spain	19,556,384	6,000	665,000	35,000	
Sweden	5,679,607	5,000	193,000	15,000	
Switzerland	3,877,210	5,000	132,000	12,000	
Turkey (in Europe)	1,891,000	250	64,000	2,000	
United Kingdom	45,370,530	150,000	1,542,000	700,000	

*In the belligerent countries of Europe it is fair to assume that the number of passenger cars in use on Jan. 1, 1917, would have been much larger than appear in the table had peace prevailed. In the United Kingdom at least one hundred thousand more cars were registered a year or more ago than are given in the table.

ASIA					
Country	Population	Estimated Number of Cars, Jan. 1, 1917	Full Parity with U. S. A.	Potential Market	
Afghanistan	6,000,000	.....	204,000	500	
Bhutan	250,000	.....	8,500	25	
British Possessions and Protectorates:					
Aden and dependencies	58,000	.....	2,000	100	
Borneo (Br. North)	280,000	12	9,500	100	
British India and Dependencies:					
British Provinces	245,069,542	9,000	8,328,000	150,000	
Native States and Agencies	71,000,000	.....	2,300,000	40,000	
Baluchistan	835,000	.....	28,000	1,000	
Fedor'ed Malay States	1,036,000	.....	35,000	1,500	
Malay Protec'd States	900,000	2,000	31,000	500	
Straits Settle'mts, The	779,977	.....	27,000	2,000	
Ceylon	4,261,000	2,200	145,000	7,000	
Cyprus	274,000	10	9,300	500	
China	320,650,000	1,200	10,896,000	25,000	
Dutch East Indies	38,000,000	8,200	1,300,000	35,000	
French Indo-China	17,000,000	500	578,000	10,000	
Hongkong and Kowloon	457,000	120	16,000	1,000	
Japan	53,700,000	1,800	1,825,000	15,000	
Chosen (Korea)	15,509,000	85	527,000	1,500	
Taiwan (Formosa)	3,600,000	.....	122,000	250	
Nepal	5,000,000	.....	170,000	500	
Persia	9,500,000	.....	323,000	6,000	
Russian Asia:					
Siberia and Steppes	14,000,000	.....	478,000	30,000	
Trans-Caucasia	7,500,000	.....	255,000	20,000	
Other	7,540,000	1,000	256,000	5,000	
Bokhara	1,250,000	.....	42,000	800	
Khiva	646,000	.....	22,000	600	
Siam	8,200,000	1,531	277,000	7,000	
Turkey in Asia:					
Arabia (ex. Aden)	1,050,000	.....	38,000	500	
Armenia & Kurdistan	2,470,000	.....	84,000	300	
Asia Minor	10,200,000	100	347,000	7,000	
Mesopotamia	2,000,000	.....	68,000	1,000	
Syria	3,675,000	.....	125,000	3,000	

AFRICA					
Country	Population	Estimated Number of Cars, Jan. 1, 1917	Full Parity with U. S. A.	Potential Market	
Abyssinia	10,000,000	10	340,000	100	
Belgian Congo	15,000,000	100	510,000	1,000	
British:					
East Africa	10,125,200	600	344,000	5,000	
West Africa	20,053,656	200	681,000	5,000	
Egypt	12,566,000	800	408,000	4,000	
Mauritius	377,000	538	13,000	1,000	
Somaliland Protecto're	300,000	.....	10,200	50	
South Africa (Rhodesia, etc.)	2,304,350	350	78,000	10,000	
Union of S. Africa	5,973,000	14,000	202,000	50,000	
French:					
Algeria	5,070,000	4,811	172,000	10,000	
Kongo	9,000,000	.....	306,000	1,000	
West Africa	10,710,000	102	364,000	1,000	
Madagascar	3,258,000	.....	111,000	500	
Somali Coast	210,000	.....	7,200	50	
Tunis	1,800,000	300	61,200	2,000	
German:					
East Africa	7,700,000	50	262,000	3,000	
Kamerun	2,540,000	10	86,000	1,000	
Togoland	1,032,000	.....	35,000	500	
Southwest Africa	95,000	.....	3,206	100	
Italian:					
Eritrea	450,000	4	15,300	100	
Somaliland	400,000	.....	13,600	25	
Tripoli, etc.	530,000	1,500	18,000	2,000	
Morocco	5,000,000	623	170,000	2,500	
Portuguese	8,207,000	50	279,000	500	
Spanish	705,768	130	24,000	250	

AUSTRALASIA AND OCEANIA					
American Possessions:	Hawaii	215,741	4,640	7,300	10,000
Philippine Islands	8,834,187	3,			

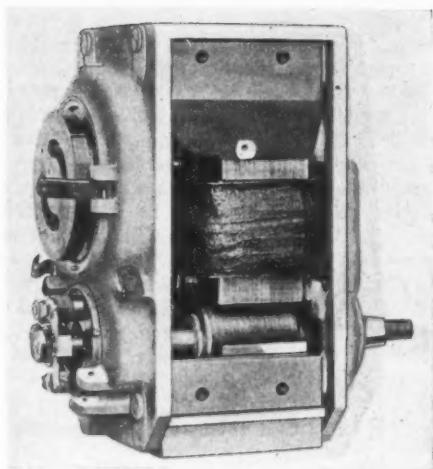
Teagle Inductor Magneto

Cleveland Concern Enters Ignition Field with Novel Magneto
Specially Designed for Truck and Tractor Work

IN view of the conditions prevailing in the magneto industry at present, more than ordinary interest attaches to the announcement of the Teagle Co. of Cleveland regarding the introduction of the new Teagle magneto. This magneto is specially designed for use on truck and tractor engines, and differs radically in structure and principle of operation from the conventional type. Every feature involved is said to have been thoroughly tried out by experienced ignition engineers. Up to the present several models have been developed for both four and six-cylinder engines, of both the fixed and variable spark types. An impulse starter can be attached to any model.

The Teagle magneto, as already stated, is of the inductor type, which means that the coils in which the current is induced are stationary, and the revolving part or rotor consists merely of a block of laminated steel. Instead of horseshoe magnets, as always used in the conventional type of magneto, the Teagle magneto employs straight bar magnets, which are carefully ground and securely clamped to top and bottom yokes. The bottom yoke forms a pole piece extending nearly half way around the rotor tunnel, while the top yoke has two poles, one carrying the windings or coils, and the other serving as a magnetic by-pass. The magnetic circuit is shown diagrammatically in the two accompanying sketches. In one the rotor pole is shown opposite the pole of a top yoke which carries the windings or coils, and with the rotor in this position, the maximum flux passes through the coils. In the other sketch the rotor is shown opposite the end of the magnetic by-pass, and in this position all of the magnetic flux passes through the by-pass and none through the coils. As the rotor has two poles, the flux through the coils passes through a maximum and a minimum twice during every revolution of the rotor.

Teagle magneto with magnets removed, showing stationary winding

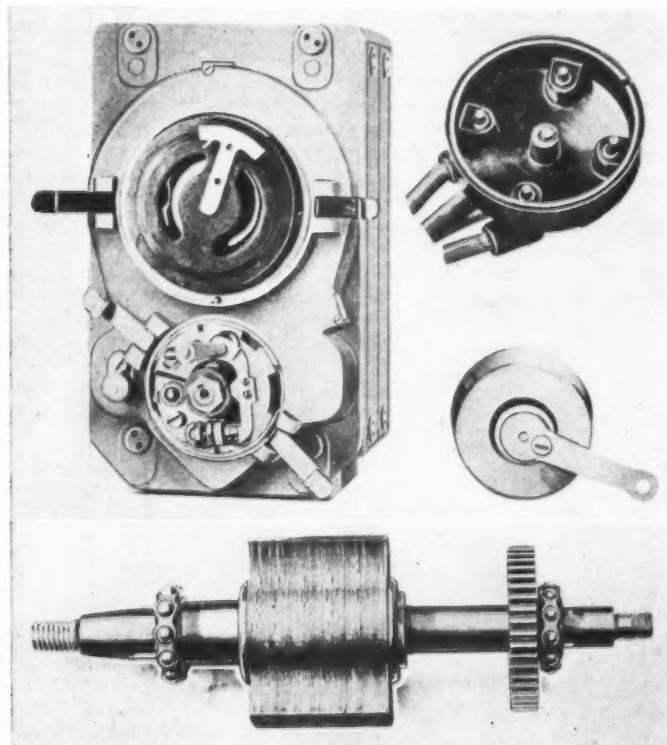


As all coils and current carrying parts are stationary, there are no slip rings or brushes, except the brush in the distributor. The distributor gears, of bronze and steel, are of ample dimensions, and in connection with the rotating member of the current distributor, are carried in steel and bronze bearings, the sleeve of which is cast integral with the front die casting. The base and top yokes are made of special electric gray iron, and are tied to the die-cast end plates by screws. They are located in place by dowel pins. The field structure is bored and ground as a unit, thus insuring accurate alignment of bearings and pole faces. The stationary coil, condenser and laminated pole piece are assembled as a unit and mounted integral with the top yoke.

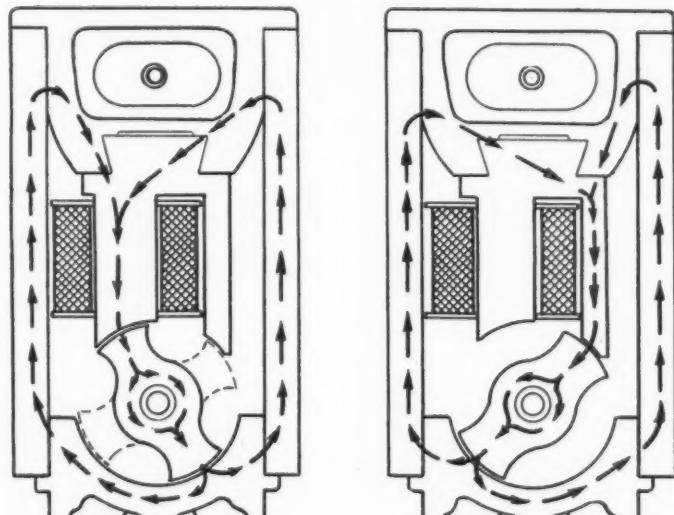
Circuit Breaker Readily Accessible

One of the illustrations shows the construction of the circuit breaker. This and the distributor, which are the only parts requiring occasional attention, are both readily accessible for cleaning or adjustment. All of the electrical connections are thoroughly protected by insulating material, and excess voltage strains are obviated by an inclosed safety gap, which, although visible and readily accessible, is claimed to be absolutely fool proof.

The Teagle magneto gives two sparks per revolution. The spark characteristics are said to be such as to insure very effective ignition, the current rising suddenly to substantially its maximum value at the beginning, and being well sustained. One feature that distinguishes the spark obtained from the Teagle from that obtained from other magnetics is that it passes through the gap of the spark plugs always in the same direction. That is to say, the same part of the spark plug is always positive.



Above—Teagle magneto with distributor and breaker cover at right. Below—Laminated armature which carries no winding

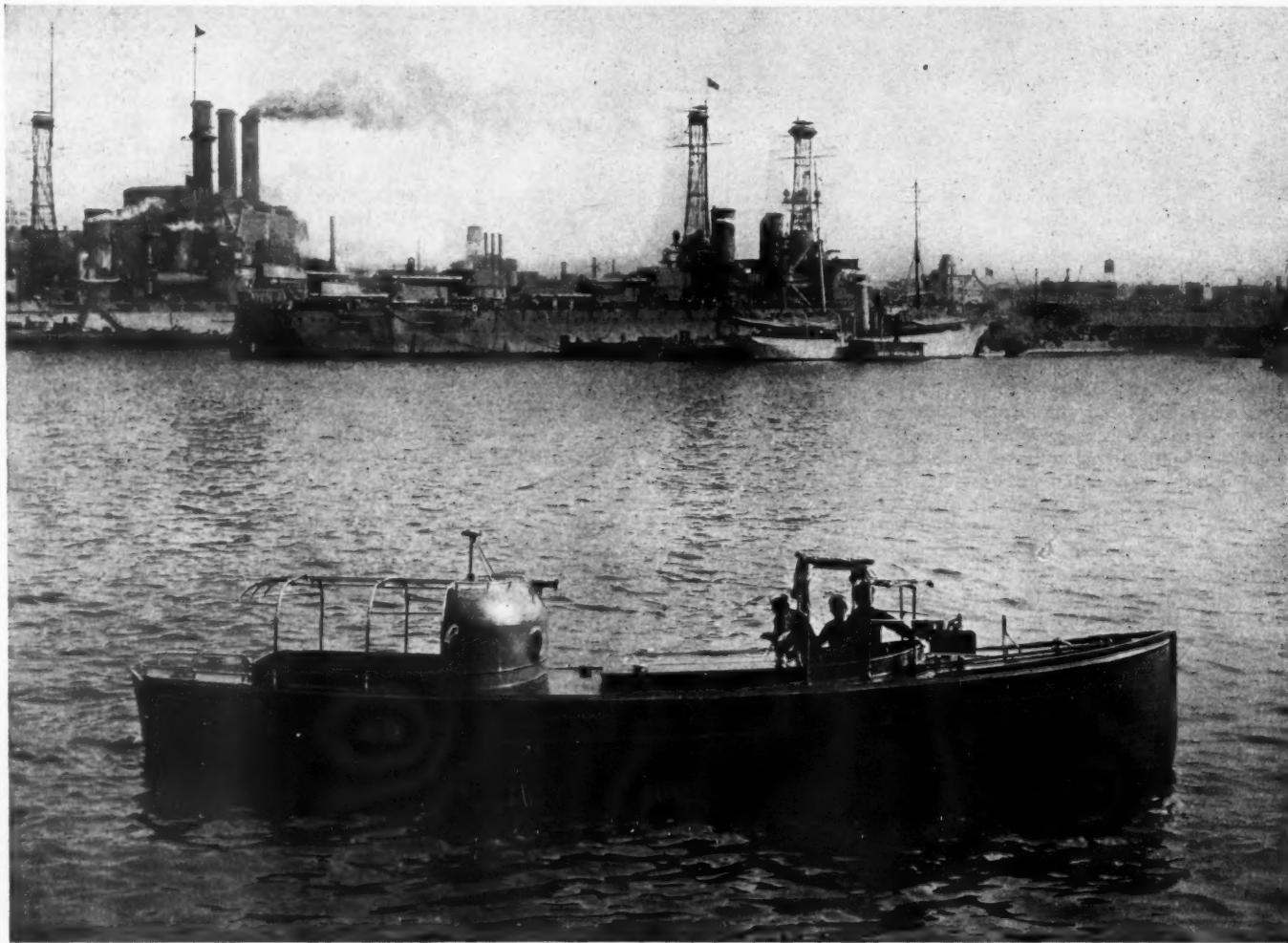


Flux diagrams of Teagle magneto, showing use of magnetic by-pass

High-Speed Engines Gain for Marine Work

War Requirements Greatly Increase Demand for Fast Power Craft—Standardization a Growing Factor—Recent Accomplishments

By J. Edward Schipper



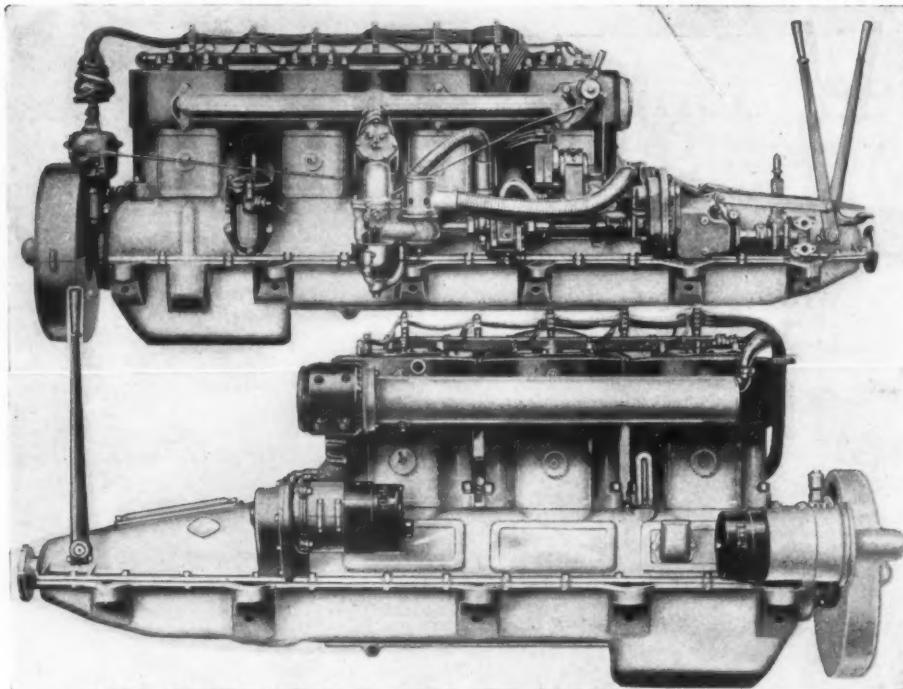
Thirty-five-foot Government barge used on all battleships, most of which are equipped with either six-cylinder 6 in. by 6 in. Van Blercks or 5½ in. by 6¾ in. Sterlings

HIGH-SPEED marine engines for small boat work have been gaining a prominence which has made a knowledge of their fundamentals a matter of necessity for automotive engineers. Owing to the great number of submarine destroyers, known as "swatters," which the Government is having built in whole or in part in every available plant, factories which hitherto have never touched marine work are engaged in turning out parts of engines or hulls. The necessity for a coast patrol of small boats has further increased the demand for high-speed marine engines, and also an ever-growing factor is the increasing popularity of fast motor boats among private users.

It is interesting to study the characteristics of the engines used in some of the latest successful high-speed boats, both of the displacement and hydroplane type, for the purpose of noting the general characteristics and requirements of motor boat engines. This branch of the automotive field is gaining in importance every day, and the recent step of the National Assn. of Boat and Engine Mfrs. in taking over all the S. A. E. standards which would apply to marine work will be but another factor in the development of the field.

One of the first considerations in a study of the smaller type of marine engines is the fact that the engine does not stand alone to as great an extent

as it does in automobile work. Practically the same power plant can be used in the average passenger car as in the average truck, with only minor variations. The engines for fast motor boats have a different set of conditions to work against. The shape of the hull and the speed at which the boat is designed to travel, as well as the varying factors of the propeller, all enter into the determination of what is the best engine to use. We have not as yet come down to standardized motor boats. There are no factories turning out a standard model with a standard engine and a standard propeller wheel in quantities which would be recognized as such by a factory in the automobile industry, for instance. It



Above—Van Blerck power plant with eight 6 by 6-in. cylinders, used in Hand's Countess. Below—Engine used in 40-ft. Government barge. These are six-cylinder, 6 by 6-in. Van Blercks

might almost be said that every boat is an individually designed proposition with the power plant fitted afterward in accordance with the desire of owner or builder. The boat and the engine are not produced by the same factories, except in rare instances, and this lack of standardization must be borne in mind when reviewing the engines used in some of the boats which have become prominent in high-speed work in late years.

Boat Speeds Increasing

Boat speeds have been increasing every year, and this is due not only to development of the engines used to operate them, but also to the improvement in hull design and in the knowledge of propellers.

Analyzing the hydroplane engine we find that the highest speed type it is possible to use for marine work is incorporated into these hulls. The hydroplane is the racing machine of the motor boat field. It is so designed that when moving forward the shape of the hull exerts a lifting influence on the boat, thereby decreasing the displacement and reducing the wetted surface of the boat with a corresponding diminishment of skin resistance.

The proportion of engine power to boat weight is so high in these crafts that they are not suitable for ordinary cruising work any more than the racing automobile would be suitable for touring. They are solely speed creations, and naturally we find in the engines the same speed developments that are found in the machines used on the speedways.

Overhead Valves for Racing Hydros

The overhead valve action is supreme, but owing to the greater capacity of the hull and the fact that there are no 300 cu. in. limitations, as we find in automo-

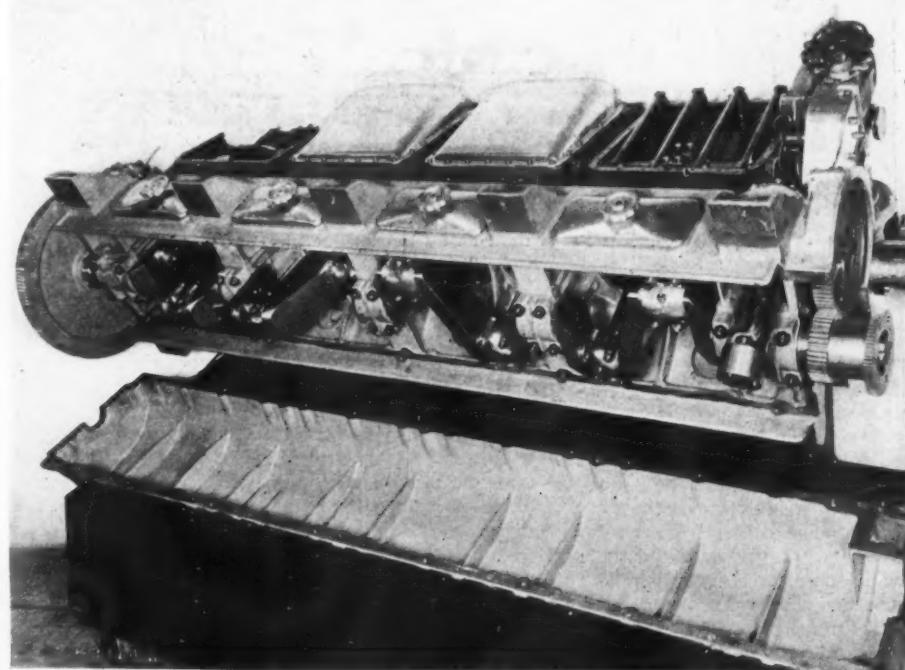
fore, it naturally takes a higher displacement to produce the same developed horsepower.

Fast displacement boats have such a variety of uses and purposes that they offer a wide field for high-speed marine engines of all types. Some typical examples of high-speed displacement boats are torpedoboot destroyers, express cruisers, runabouts, Government barges, and submarine chasers or swatters. The lengths of the displacement boats, even of the highest speed type, are considerably in excess of the racing hydroplanes. For example: Miss Minneapolis and Miss Miami, probably the two fastest hydroplanes afloat, have lengths, respectively, of 20 ft. and 22 ft. The fast express cruisers, or displacement boats, such as Hand's Countess and Sophia II, are 40 ft. long. The Marycel is also 40 ft., and Raven III and Shadow III, two well-known displacement speed boats, are 50 ft. long. The Government barge used as a high-speed tender is 35 ft. long.

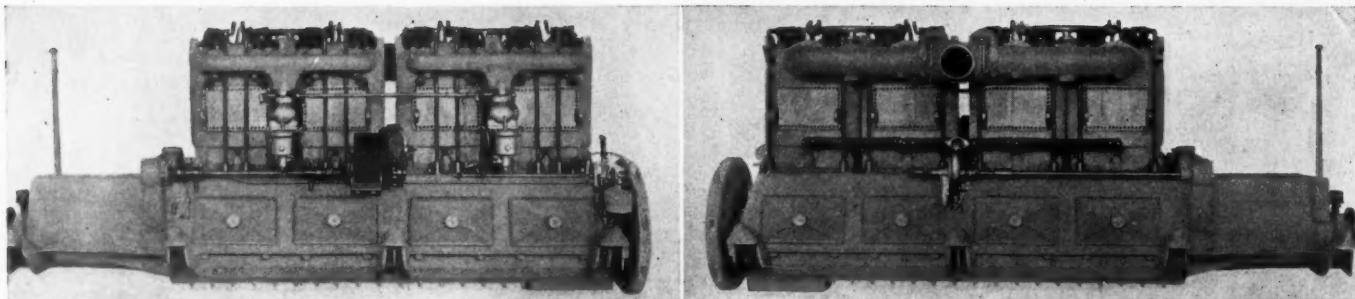
Maximum Speed 67.9 M.P.H.

Probably the maximum speed to be recorded in a motor boat was made on April 21, 1917, by Miss Miami, which is stated as 67.9 m.p.h. for 1 mile, and an average of 66.5 m.p.h. for 4 miles over a measured course of 1 mile at Miami Beach. If this speed is allowed as official it creates a new record. The present standing record for motor boats was made by Miss Miami in September, 1916, at Detroit, when a speed of 61.083 statute m.p.h. was attained. These are hydroplane types of boats and represent the highest development of racing hull design.

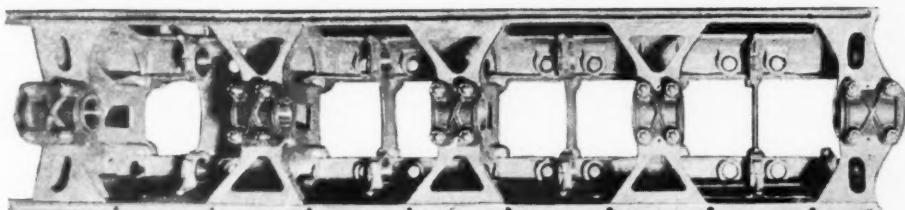
The engine in Miss Miami which, if the record is allowed to stand, is the fastest motor boat afloat, is a Curtiss V twelve-cylinder type, with the cylinders at 60



Illustrating the crankcase construction and the valve action of the patrol Duesenberg engine used in the S. P. 54



Left—Intake side of the Sterling engine such as used in the Miss Minneapolis and Sophia II. Right—Exhaust side of the Sterling engine such as used in the Miss Minneapolis and Sophia II



Crankcase which really forms the power plant backbone of the Miss Minneapolis, one of the fastest hydroplanes afloat. This is equipped with a Sterling engine

deg. The bore and stroke are 5 by 7 in., and there are two valves per cylinder, and four Zenith carburetors for the engine. Ignition is furnished by two Dixie magnetos. The engine has aluminum crankcase and aluminum pistons. It is water cooled and pressure lubricated. The engine is rated at 250 hp. at 1400 r.p.m. The pressure lubrication is worked out on a complete force feed basis. The pressure is directly through to the wristpin by means of a tube fastened to the web of the connecting-rod by means of riveted clips. There are two plunger suction pumps driven off the camshaft. The cooling pumps are also double and are driven off the crankshaft. They are centrifugal type, and one set of gears

takes care of all auxiliary drives. The waterjackets are monel metal, brazed on.

The pistons have two eccentric rings above the wristpin bearing. The pin bearing is in the aluminum piston, with the wristpin clamped in the rod and held in place by means of a set screw. The crankshaft is alloy steel with seven bearings and having six throws. The rods are single ended and set side by side on the crankshaft. They are chrome vanadium steel.

The valve action is overhead with rocker arms and push rods. There is a single seven-bearing camshaft, and these act directly on the overhead valves. The valve action is illustrated in the accompanying drawing.

An idea of the size of the motor of this type, which has a displacement of 137.44 cu. in. for each cylinder and a total of 1649.28 cu. in. for all twelve, may be given when it is stated that the overall length is 84.5 in.; the width at the top of the cylinder, 34 $\frac{1}{4}$ in.; the height above the center line of the crankshaft, 24 $\frac{1}{2}$ in., and the depth, 15 in.

The boat is a single-step hydroplane having a length of 22 ft. and a beam of 6 ft. 10 in. A noteworthy fact is that the engine is practically one-third the length of the boat. The details of the propeller of this boat, as is generally the case with the high-speed racing hydroplanes, has been kept secret.

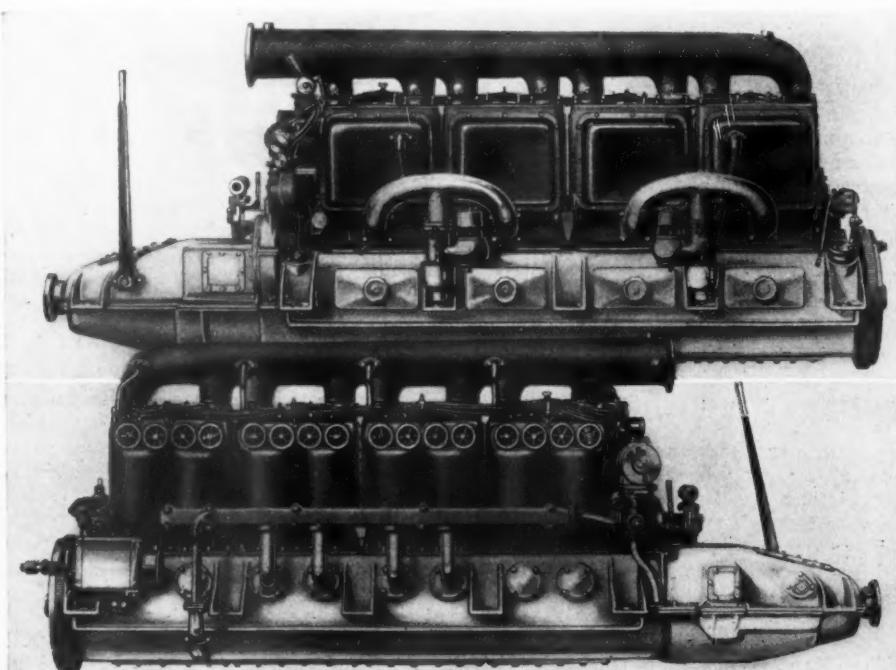
Miss Minneapolis Sterling Equipped

Miss Minneapolis, which established the record last September in Detroit by making 53.116 knots, or 61.08 m.p.h., is of course a hydroplane type of boat. She is equipped with a eight-cylinder Sterling racing motor having a 5 $\frac{1}{2}$ in. bore and 6 $\frac{1}{4}$ in. stroke, developing in the neighborhood of 250 hp. This engine won the gold cup of the American Power Boat Assn. for 6 successive years for the hydroplane type of boat.

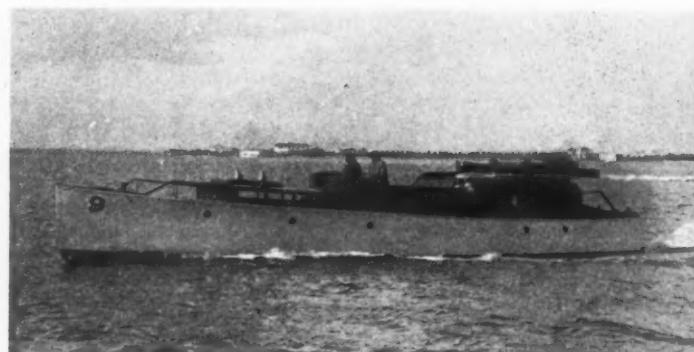
In 1915 the Miss Detroit, a 25-ft. hydro, built by the C. C. Smith Boat & Engine Co., Algonac, Mich., and owned by a syndicate of Detroit citizens, covered a half mile course at the Chicago carnival at the rate of 56.25 m.p.h. Other notable boats in which this engine has been incorporated are Tech, Jr., a 20-ft. single step hydroplane owned by Col. T. Coleman du Pont, which made a speed of 54.46 m.p.h., and Barnacle II, a 50-mile hydro, owned by Charles N. Steele, of Chicago. This boat was the winner of the Panama-Pacific International Exposition Regatta, San Francisco, 1915.

Cylinder Overhead Valve Type

This engine develops its 250 hp. at 1700 r.p.m. The eight vertical cylinders are overhead valve type, cast in pairs and made from special analysis semi-steel. The upper base is a one-piece casting of manganese bronze, having the axis of the crankshaft above the dividing line of the crankcase. The main bearings are supported in a form of truss on which the Sterling company has patents. This construction carries the crankshaft in the upper part of the crankcase. The supporting bearings are removable and can be taken through hand hole plates on each side. The lower part of the crankcase is a one-piece aluminum casting



Above—Power plant of the Marycel. This is an eight-cylinder Duesenberg having a bore and stroke of 6 $\frac{1}{4}$ in. by 7 $\frac{1}{4}$ in., and developing from 275 to 400 hp. Below—Exhaust side of the Duesenberg power plant in the Marycel



Left—Miss Minneapolis—1916 champion. Official speed better than 63 m.p.h. Powered with Model R 225-250 hp. Sterling racing motor. Designed and built by C. C. Smith Boat & Engine Co., Algonac, Mich. Right—Shadow III, 50 ft. by 9 ft. express cruiser, owned by Carl G. Fisher, Indianapolis, parent of the Indianapolis speedway. Created world's record at Miami Regatta by winning race on third day at average of 30.1 m.p.h. This boat is powered by a pair of eight-cylinder Speedway motors developing in excess of 200 hp. each. One of these is illustrated below.

which supports the upper case, the thrust bearing, the clutch and reversing mechanism.

The pistons are of hard gray iron with phosphor bronze bushings for the piston pin. The connecting-rods are I-beams forged from 0.35 carbon steel, annealed and heat-treated. The crankshaft is a drop forging of chrome nickel steel, having an elastic limit of 120,000 lb. per sq. in. The diameter is $2\frac{1}{4}$ in. The flywheel is carried on the forward end of the engine and bolted to a flange on the crankshaft. It is a gray iron casting, machine finished all over.

The camshaft is nickel steel. It is driven from a set of timing gears housed in the end of the crankcase, and the cams act directly upon ground push rods which operate in bronze guides. Valves are tungsten steel.

Gear Type Pressure Pump

Ignition is by double two-spark magneto, cooling by centrifugal pump, and lubrication by means of a hollow crankshaft, force feed, in combination with a modified splash system. The pressure pump is a gear type made of bronze. The weight of this engine, including the reverse gear, is 1450 lb., and its price with full equipment is \$3,000.

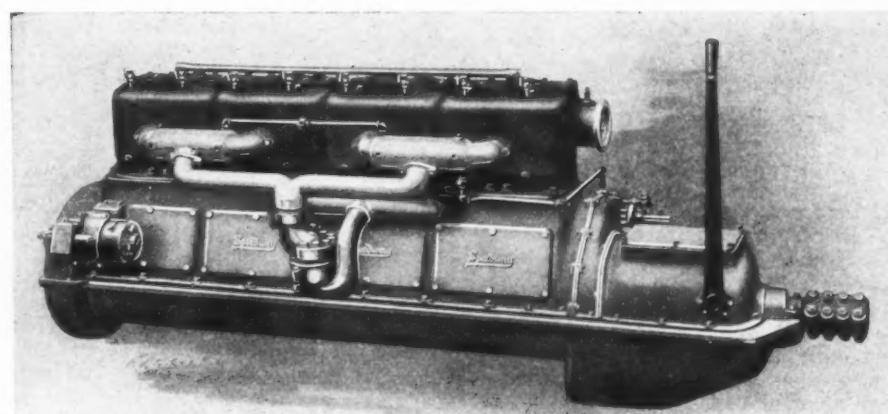
Sophia II is powered with a Model F, eight-cylinder, 200 hp. Sterling engine, having a bore of $5\frac{1}{2}$ in. and a stroke of $6\frac{1}{4}$ in. She is of the type known as express cruiser, and measures 40 ft. 5 in. long by 9 ft. 2 in. beam, and 3-ft. draft. She was the 1916 winner of the South Jersey Express Cruiser Championship, attaining a speed of 30 m.p.h.

Runabouts of the displacement type having no cabin accommodations and hence much less wind resistance, attain speeds considerably higher than this. The speed of 30 m.p.h. for express cruisers is about that attained by the winners during the last season.

The Champion Countess

Another good example is Hand's Countess, which won the 1916 express cruiser championship and the Block Island race. This was also a 30 m.p.h. boat.

The engine equipment in the Countess is a Van Blerck eight-cylinder, 6 by 6. The Sterling engine used in the Sophia II is a Model F high-speed type, ranging from



Speedway eight-cylinder 5 1/4 in. by 7 in. engine used in the Shadow III, the fast displacement boat illustrated above.

—1200 to 1400 r.p.m. A great many of the express cruisers for volunteer patrol boats are using engines of this type. It is a eight-cylinder design with all parts inclosed. The cylinders are vertical and cast in pairs.

One of the features of this engine is the unusually large bearings, the main bearings being 5 in. long at the ends, with the intermediate bearings 4 in. long. The connecting-rod bearings are $2\frac{1}{2}$ in. in diameter and $3\frac{1}{2}$ in. long. With this bearing equipment and the comparatively low bearing speeds in marine practice as compared with automobile design, it will be seen that bearing trouble should be correspondingly lower. The diameter of the crankshaft is $2\frac{1}{2}$ in. The shaft is counterweighted, with the counterweights located in the bearings. Some of the specifications of this model Sterling engine are as follows:

Cylinders, T-head of semi-steel; upper crankcase, manganese bronze; lower case, either gray iron or aluminum alloy; pistons, semi-steel; lubrication by pressure through crankshaft and electric starter; generator, storage battery and high-tension magneto included with regular equipment.

Van Blerck Engine

The Van Blerck engine used with Hand's Countess, which, as stated, is a square type 6 by 6, eight-cylinder vertical design, develops 205 hp. at 1400 r.p.m.

The cylinders are T-head of gray iron, containing approximately 10 per cent steel. They are cast in pairs. The upper half of the crankcase carries the crankshaft and is of material designed to maintain the alignment of the engine, owing to the fact that it supports the crankshaft. This construction also permits of a ready inspection of the interior motor parts without removing the foundation bolts of the engine. A feature of the Van Blerck engine is the fact that the cams are forged integrally with the camshaft. It has been general practice in motor boat work to use the built-up camshaft. These shafts are $1\frac{1}{16}$ in. in diameter and supported by bearings between each pair of cylinders.

Worm Gear Integral with Camshaft

The worm gear driving the main oil delivery pump is forged solidly on the camshaft and cut before being hardened. The pistons and rings are semi-steel castings, machined and ground to dimensions. The pistons and rods are both of extra length to reduce the side thrust over the greatest possible area. The rings are $3/16$ in. in width.

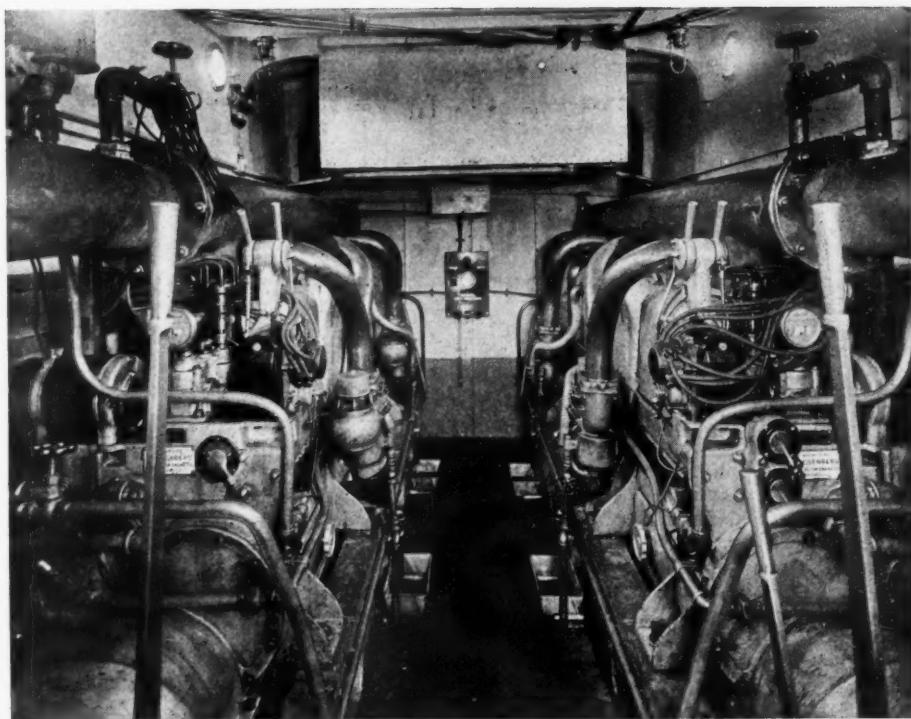
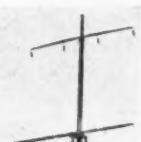
Electric lighting and starting is furnished on the engine, a Leece-Neville system being employed. This is a two-unit starter and engages with the flywheel by means of a Bendix gear.

The Van Blerck engines are notable also for the fact that they are of standardized

design, whether they are bought in four, six or eight cylinder units. The same cylinder blocks are used, and the number required are mounted on the crankcase.

The same type of engine as is used in the Hand's Countess is also employed for the Government barge, except that it has six cylinders, 6 by 6. The Sterling engine is also used on some of these barges, in which case a six-cylinder, 5½ by 6¾ in. model, is used. The bureau propellers indicated in the tabulation were designed by Captain Dyson, of the Bureau of Steam Engineering, Washington.

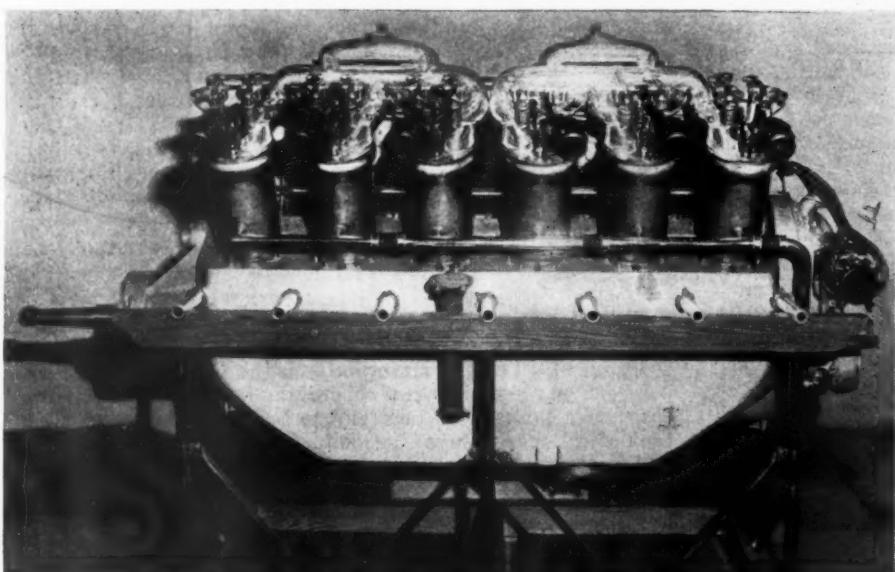
Raven III and Shadow III are the fastest boats. They are 50 ft. long, 9 ft. beam, and 3 ft. 6 in. draft. Both of these were equipped with eight-cylinder Speedway engines, 5¾ in. bore and 7 in. stroke. The engines are L-head vertical types. The cylinders are cast in pairs, with integral heads and water jackets. The engine frame is a one-piece casting, with large hand holes having the cylinder bolting flange near the center of the



Engine room of the S. P. 54, one of the submarine swatters on patrol duty on the Atlantic Coast



One of the naval reserve patrol squadron, which was formerly the Bonita. It is commanded by her owner, Herman Oelrichs, who turned her over to the naval reserve at the time war was declared. It is equipped with two eight-cylinder patrol Duesenberg engines developing 350 hp. each



Curtiss engine used in Miss Miami, the hydroplane which is said to have established a new speed mark at Miami Beach

piston travel. On the after end of the engine frame is a cast gear cover which contains outboard bearings for the cam and auxiliary shaft gears for the purpose of eliminating overhung gears. The water pump, electric generator and magneto are on the side of the frame, and there are also provisions made for driving a slow speed bilge pump and a whistle pump.

The pistons are cast iron, fitted with four rings and with tubular steel case-hardened wristpins. The crankshaft is hollow and 3½ per cent nickel steel, with a diameter of 2½ in., finished all over and ground at the bearings and pins. Both the inlet and exhaust valves are alike. They are taper seated, with nickel steel heads and machine steel stems, mechanically operated from a single crankshaft. The valve operations and all the other valve operating mechanism is inclosed. The provision made for keeping the gears quiet is the same as would be expected in automobile practice. They are of steel against cast iron, with extra wide faces and helical teeth.

The engines in the Raven III and Shadow III attain a maximum of about 1350 r.p.m. The wheel used has a diameter of 22 in. and a pitch of 32, and is a Columbia. It has three blades with approximately 180 sq. in. of developed area. Turning at 1350 r.p.m., the slip is 20 per cent.

Marycel a Fast Runabout

One of the most interesting of the displacement runabouts is the Marycel. This is 40 ft. long with 9 ft. beam, and claims to have the record of making the fastest time of any displacement runabouts. This is a speed of 37.7 m.p.h., which it attained in winning the 15-mile race for displacement runabouts at the Third Annual Miami Regatta this year.

(Continued on page 1260)

Features of War-Truck Design

Part I

European Western Front Experiences Show Many Details Which Could Be Improved—American Specification Not Ideal*

By Owen Thomas

THE trucks used in France by the British Army at the beginning of the war were mostly of the commercial type not especially designed for war service. This was true of the trucks made in Europe as well as those sent from America. A very small number of the so-called subsidized British War Office pattern had been built; the majority were taken out of regular commercial service. Many of them had been in use as omnibuses by the London General Omnibus Co. and the bodies were replaced by others quickly built to meet the emergency. Some of the European-built trucks were fitted with four-speed transmissions of the commercial type, mainly to permit the use of smaller engines and greater fuel economy.

The greater part of the English and American trucks were divided into nineteen different makes and forty-two different models of widely varying design, so that the problem of providing spare parts and maintaining the trucks in service soon became very great. The makers were working overtime producing new trucks and there was a consequent shortage of spare parts.

Main Trouble with Minor Details

My first study of the maintenance problem showed that some vehicles had been out of service from 3 to 5 months and that a large number of one make of American trucks, which was in general giving good satisfaction, were out of commission on account of shortage of clutch thrust collars, gear shifts, fan bearings and front wheels. It was soon evident that the majority of the troubles were not with the main points of design but with gear ratios and other minor details.

Many trucks were too low geared on high to stand the test of high engine speeds in emergency and these naturally developed engine trouble, broken crankshafts, etc. All of them were too high geared on low and reverse to operate successfully under the bad road conditions which the German shells were constantly rendering worse with the co-operation of the heavy rains and floods.

It must not be supposed that an ideal war truck should be something not adapted to general service conditions. The constant heavy duty under which the war truck is operated must produce a simpler, more reliable and more easily maintained truck for use under ordinary commercial conditions. The war truck is generally driven by a man who has never driven a truck before and who probably has never even driven a touring car. He is recruited as a soldier and afterward trained as a mechanical transport driver. In the English army he is a private in the Army Service Corps, and the officer over him is also likely to be new at the truck game.

The Army Service Corps in England deals mainly with the problem of feeding the men and horses of the army. The transporting of the food came under an Army Service Corps officer called the Director of Transport and Supplies, and the transport work by horses meant principally the addition of a little more forage. When the horse transport was superseded by motor trucks the system still remained under the control of the same officer, although he had very little mechanical experience. The problem gradually changed to one of mechanical operation, but in the English army the administration of it is still an adjunct of the commissary.

In the French army before the war the use of motor vehicles was much further advanced and was part of the artillery command. The officers in this command were technically trained and well equipped for the problem, but in both the English and French armies it was necessary to call in men who had had previous engineering experience in automobile subjects. Personally I can see the need of keeping the mechanical transport operation and maintenance separate from the older departments of the army, although it might be possible to combine the maintenance facilities of the automobile, auto truck and aero sections.

Reserves Are Necessary

The training of the army personnel in the use of mechanical transport is important in order that the trucks in use may be properly operated and maintained. The men, like the trucks, need steady reinforcements and replacements amounting to 3 per cent per month even after the army is complete in the field. Besides the training of these additional men 2 months' reinforcements must always be available at the advanced base, and 2 months' reinforcements at the base, where they can undergo additional training until they are called.

The training of a transport private or officer takes about 3 months outside of their training as soldiers. It is necessary to divide the training of both into three distinct parts: First, the ordinary school or book knowledge of the subject in the Mechanical Transport School; second, driving and operation; third, system of maintenance and repair. I am satisfied that a thorough training of the personnel more than pays for itself in the condition of the equipment afterward, and that what has been found necessary in this direction should be given careful consideration by the United States Government in building up the mechanical transport division of its army.

It is difficult for the average engineer and writer to compare European trucks at the front with those sent over from America. They are good and bad from entirely opposite standpoints. The European trucks for the main part were better designed in detail and much more refined than the trucks sent from America, but their parts were not nearly as interchangeable and it was more difficult to repair them on account of the hand-fitting which is an essential feature of the system under which they are manufactured. The parts of some of the American cars and trucks were interchangeable to an extent which was beyond the comprehension of the average British or French officer.

Keeping a Stock of Spares

To maintain trucks in the field the English army ordered a list of parts for every truck varying from 10 per cent of the total of all of the main units on the trucks in use to 100 per cent of all nuts, bolts, carburetor floats, bearings, washers, brake linings, gaskets, clutch facings, etc., and 200 per cent of all spark plugs, fan belts, hose connections, etc.

After the trucks had been in service for some time a monthly list was prepared for the parts which experience showed were needed to maintain them in service. This list is known as the 3 per cent list because it contains 3 per cent of all main units in service and up to 100 per cent spark plugs, etc. A stock of these parts equal to a 6 months' supply is carried at the various bases. This stock, besides being

*Paper presented at S. A. E. summer meeting, Washington, D. C., June 26.

added to by the regular 3 per cent monthly list, can draw in emergency from the reserve stocks at the base, which are replenished by special orders.

While 3 per cent of the main units are allowed in an assembled condition each month, all of the separate component parts of these units are also carried in an additional proportion. For instance, crankshafts are an additional 3 per cent, bearings from 10 to 30 per cent, etc. About 2 per cent per month of the complete trucks in service are also replaced with new trucks on account of being beyond repair with new units or parts.

Entire Truck Replaced in 8 Months

If all of the above allowances for repair and replacement were used up in any given period and charged at the same rate as the parts in the original truck, it will be found that each original truck had been entirely replaced in value after about 8 months' service. Actually, the list of replacement parts is always enough to maintain more than a balance, so that the nominal life of the truck is for a slightly longer period. With this life, the investment for trucks and replacement parts f.o.b. factory averages about \$16 per day per truck in service, which for war conditions is a very creditable showing for mechanical transport.

The need of standardization of parts cannot be too strongly emphasized. After going through this problem under actual war conditions it is easy to realize the enormous saving of time and expense in the shipment and replacement of repair parts if the units of the various trucks are rapidly replaceable by having their main dimensions and supporting points standardized. Personally I feel that the standardization should be carried out further than this, as the problem in the field is to quickly repair the unit which has been removed from a truck.

I remember seeing in France 180 cars of one Detroit make, all with the same complaint. They were ready for use except for one gear in the transmission and a condenser. Some of them had never been in service but had been robbed for the repair of others at the front.

On another occasion I was able to supply a differential intended for a touring car axle as a repair for the jackshaft of a fire truck, which otherwise would have been out of service for a long time. In England to-day under government control many companies are using details belonging to other cars and trucks without the necessity of making additional dies or tools. My impression is that much time would be saved by starting out at once to standardize along this same plan.

Government Standardization Possibilities

In order to effectively standardize, the government must assume the responsibility for the design used, for the distribution of the material of the proper quality, and for the manufacture of all forgings and similar parts needing dies and special tools. Such a design should be utilized to an extent not hitherto possible. For instance, the clutch housing should support the clutch-operating mechanism, the transmission unit should be integral with the gear shift, and all operating mechanisms should be integral with and supported upon the units they control and not be separately supported on the frame. Much of the derangement of parts caused by damage to the frame itself would be thus avoided.

Care should be taken in the adoption of a standard that all of the parts are enclosed and protected against mud and weather. I have seen an artillery ammunition park stationed at the roadside for such long periods ready to move toward the front that it was necessary to tie up the brake mechanism with canvas and to cover the radiator, wheels and other exposed parts in the same way to prevent them being rendered inoperative by the splashing of mud from other passing vehicles.

The English army uses principally one size of truck of 3-ton capacity somewhat larger than the U. S. Class A specification. Smaller trucks are called for to handle hay and oats, as these do not weigh so much as some of the other stores. In practice, however, these loads are very bulky and are carried in the largest body available.

The French standard trucks are 2 and 5 tons, the 2-ton

truck being somewhat smaller than the Class A and the 5-ton truck being about the same as the Class B specifications.

The trucks are normally operated at from 12 to 15 m.p.h., but the governors are usually set to allow of a speed of 18 to 20 m.p.h. in an emergency. Very often the governors are disabled, and a great many trucks are not provided with governors at all.

Most of the trucks in France are geared so that their engines will operate continuously at 18 or 20 m.p.h. on high gear in emergency. They are also required to operate on second gear up to a normal speed of 12 m.p.h., so that in an undulating country the convoy is not spread out by vehicles slowing up on the hills. The later trucks designed have a reduction of fifty to one on low gear in order that they will maneuver on low and reverse under bad road conditions without it being necessary to race the engine in starting.

It is found in practice that even the axles do not suffer as much by this extreme reduction as by racing the engine and letting the clutch in, as is necessary with some older type trucks sent from America.

Many of the early trucks were found wanting on account of insufficient road clearance. This has been remedied in the later designs by the adoption of transmissions with the lay shaft placed sidewise of the main shaft by double geared rear axles and by the use of the heavier smaller diameter flywheels than formerly. The ground clearances demanded in the United States specifications are approximately what have been found necessary in practice in France.

Steering Angle Must Be Wide

For the sake of operating in narrow places rather than of turning around in a smaller circle it is necessary that steering to an extreme angle be allowed for. This turning circle limits the frame width, and it could be best specified by standardizing the width of frame of Class A truck to 33 in. and the width of frame of Class B truck to 34 in., which widths agree with the standard widths of rear spring seats and permit the use of a uniform 26-in. engine arm.

The standardization of tire treads is very important. The front tires should be the same gage on center lines as the rear tires rather than have the front and rear tires line up on their inner edges, as this makes steering very difficult and rubs the inner edge of the front tires. It will be found that this condition exists in the class A United States specifications.

The engines of American trucks in France often gave trouble from the fact that they were not sufficiently run in before they were put into hard service. The engines must be of a heavy duty type designed and balanced to run at a continuous speed of 20 m.p.h. on high gear in emergency.

The war has developed more improvements in engine details than in general design. Plain bearings without oil grooves have come into much more general use. The use of floating piston pins and floating connecting-rod upper bushings has also come to stay. Many fixed piston pins in engines giving serious trouble have been replaced in the field with floating pins which have plain cast iron stoppers to prevent the steel pins rubbing the cylinder sides.

Valve push rod roller pins have also been replaced in the same way with floating pins, and in general the lesson has been learned that for heavy service a floating pin or bearing is not only more easily replaced in the field, but shows much less wear than a fixed surface with concentrated pressure on one point.

Separate Clutch from Engine

The rear bearings of engines suffer considerably from the overhanging weight of clutches and universal joints and from the pressure caused by the non-alignment of annular bearings with engine bearings in the case of inclosed unit clutches. The latter is especially evident when the engine bearings have been re-scraped and taken up, and occurred to such an extent that I am convinced of the need of the complete separation of the clutch from the engine unit. The universal joint can then be brought up close into the flywheel, which in turn should also be carried well forward so as to overhang the rear bearing as little as possible.

(To be continued)

Factors in Aviation Engine Design

Part III

Alloy Pistons Standardized with Good Results— The Materials Problem—Connecting Rod and Piston Design Details — Carburetion, Oiling and Cooling

By Louis Coatalen

Chief Engineer Sunbeam Motor Car Co., England

EDITOR'S NOTE—Louis Coatalen is recognized as one of Europe's leading automotive engineers. Born and educated in France, he began his work there, joining Humber, Ltd., of Coventry, about 1905, and producing the first British car with any reasonable high gear performance. Since his association with the Sunbeam company this car has ranked with the best. His racing cars hold many records. The Sunbeam aviation engine has been the principal product of the factory since the second year of the war, and is reckoned among the best of the European airplane motors.

AT this point I should mention that for about 2 years I have standardized aluminum alloy pistons with excellent results. Even when they have been made with a green sand core no real trouble can be said to have been experienced with them. A point to note, however, is that the greater clearance needed when the aluminum alloy piston is cold represents a disadvantage in comparison with cast-iron pistons, which has not been overcome yet.

Another special alloy is being used in place of gunmetal for the construction of the oil pump employed for the forced feed lubricating system. These details are of the gear-wheel type. As regards both strength and bearing qualities the alloy employed has proved to the full as satisfactory as the gunmetal used formerly.

Materials Situation in Review

Before quitting the subject of materials in general, at this juncture it will be convenient to pass the general situation in rapid review. Manufacturers have been called on to make immense efforts in the matter of supplying a wide variety of materials for multi-cylinder aircraft engines. They have met and mastered right ably the usual sequence of difficulties that materialize whenever man attempts to break fresh ground. In particular, the high-tensile steel stamping now being supplied, for instance, for a six-throw crankshaft for a 500 hp. aircraft engine is a splendid example of the steelmaker's craft to-day. There would have been no call for it had not the advent of war made it necessary on a sudden for us to standardize in these islands aircraft engines of high output. Of course, the necessity for using unprecedentedly high-class materials for these constructions has presented alike steel makers and alloy producers, as well as the engine makers' machine shops, with a series of fresh problems which have had to be overcome detail by detail before it has been possible to obtain that degree of success which is necessary ere any given product can be regarded as a practical proposition.

More Skill and Knowledge Needed

Briefly, there has had to be an all-round improvement in method. More scientific control has had to be exercised and procedure elaborated. Obviously, there has been a call for devoting the greatest attention to detail, since it will not suffice merely to employ more expensive workmanship and higher grade materials. In regard both to design and to procedure, each part must be accorded, besides, greater attention to detail than any that has sufficed for car engine design and production to date. In what direction this extra study is needed is discovered, of course, by the laborious process of experiment. After that knowledge has been attained, when it comes to standardizing practice in the shops, very special attention has to be given to avoid points likely to start fatigue flaws. At this stage these are a prolific source of trouble in the production of aircraft engines. Each

man has to be trained to give the correct proportion of attention to the various details of his job; therefore a more highly-skilled class of labor is needed. Your individual worker must know precisely what function his particular task and the part which he is engaged in fashioning plays in the scheme of the complete and, necessarily, at present somewhat complicated aircraft engine. Though only a matter of lightening, such details as boring parts, with which the car engine builder is not concerned, have to receive more than ordinary intelligent and conscientious attention during manufacture.

Connecting-Rod Forms

Of course, both the radial and the V-type aircraft engine have introduced problems of design, the solution of which does not appear to be unanimous yet. In these varieties of engine design you have more than one piston attached to each crankpin. The diversity of opinion concerns the means by which this is done. Naturally the design of 8- and of 12-cylinder standard engines for car service, such as our American friends are producing in large quantities, does not call for the same amount of care in this regard that is essential in the case of the more heavily loaded aircraft engine. The original form was that in which the end of the subsidiary connecting rod is mounted on the outside of the main connecting rod. This, however, makes relatively a very heavy big end not suitable for engines from which is demanded the high duty necessary for aircraft service, as the wear of the big end is controlled by its weight and oil pressure.

A lighter construction is achieved by the link-rod method, wherein the subsidiary member is attached to the main one by a pin placed as near the centre of the crankpin as possible. This arrangement has the additional advantage of rendering it considerably simpler to take up any wear in the big end bearings. For obvious reasons, in the former type that operation is not a very easy one. The latter type, however, introduces a further problem. Owing to the centres of the bottom pins of the subsidiary rods not being coincident with the centres of the main pins, the movement of them is along an elliptical path in contradistinction to that of the crankpin, which, of course, is circular. The ellipse has the effect of altering the stroke of the piston attached to the subsidiary rod. The extent of the variation depends on the angular position of this pin with the centre line of the main connecting rod, the distance from the main pin to the rod pin remaining constant.

Variation of Stroke

It will be readily appreciated that the length of the piston travel can be corrected by tilting the axis of the ellipse in such a manner as to give the precise stroke desired. Owing to its change of velocity, also to its greater stress on the

main rod due to the reversal of that rod during the firing stroke, this would have the further effect of altering the acceleration of the piston attached to the link rod. In going into this question the author came to the conclusion that the variation of the stroke was the lesser of two evils.

The design adopted in certain radial engines, in which gear-wheels are used to maintain the correct position of the link-rod pin, is a very clever method of overcoming these difficulties. Nevertheless, it makes for relatively heavy construction and tends to provide a further cause of mechanical failure.

In the case of the three-row 18-cylinder 500 horse-power Sunbeam-Coatalen aircraft engine, the design of connecting rod arrangement in regard to the link pin details is such that the centre row of pistons that are attached to the main rod of each series have a travel of 160 mm., while each of the pistons of the two side rows of cylinders has a stroke of 168 mm.

As it is essential to employ as light a connecting rod arrangement as possible, the question of loads on the bearings becomes of great importance.

Despite the fact that one engine of great power has been designed with balance weights and has certainly given satisfactory results as standardized, and that, of course, these can be used in car practice, nevertheless such accessories are practically precluded in the case of the latter-day aircraft engine on consideration of the weight per horsepower of the given engine.

Lubrication

As has been indicated, lubrication is prominent among the matters that illustrate the difference between car and aircraft engine design and practice. While everything possible is done to reduce the bearing pressure in the aircraft engine, nevertheless in practice it is found that the best design is one in which less bearing surface is allowed than obtains in the case of the car engine. This is rendered practicable in the aircraft engine by giving more careful consideration to the problem of lubrication. Thus a pressure in the oil circuit up to 100 lb. per square inch is being used. This insures an excellent condition of bearings, while the design of the oilways in the bearings themselves is such as to prevent excess of lubricant getting to the pistons.

Because an aircraft engine has to carry its supplies of lubricant aboard the machine, obviously it is only less desirable to ship an excessive amount of oil for any given flight than it is to carry too little. Moreover, the fact that the engine bearing pressure is much higher than in motor-car practice, and as much more heat is generated and has to be absorbed by the film of oil on which the lubricated surfaces are floated, renders it impossible to carry the oil in the base-chamber, as in ordinary motor-car engine practice. In aircraft engine design you aim at achieving the maximum economy of lubricant consumption in combination with maintaining effective pressure in the system by preventing the oil becoming too hot and thereby losing its viscosity. Therefore you design an aircraft engine with what is styled a dry base-chamber, placing the oil supply in a tank set somewhere else in the machine, probably in the slipstream of the propeller, so that it may be exposed to the maximum draft and its contents cooled as rapidly as possible, to be served again to the engine by the intake pump in connection with the pressure system. The relief valve returns all excess oil to the tank and the expelling pump at the bottom of the base-chamber withdraws all the lubricant that, having escaped through the connecting rods and served the details that are oiled by the splash system, returns as filtered residue to the tank, where it is cooled as quickly as possible, and therefore made ready to be passed into the engine system again. Experiment has proved that for a long run under full load it is necessary to force the oil through some sort of cooler placed in the air-stream in a similar way to the radiator. Likewise the design of base-chamber must be such as to act as a cooler of sorts for the oil passing down from the crankshaft and other details to the sump. Of course, the high pressure to which reference has been made is needed in connection with the main bearings, the crankshaft, and the connecting rods only. In this regard a great advance has been made recently by providing a supplementary pump of small capacity which

serves to lubricate the minor parts of the engine that do not need high pressure. This insures that these minor parts get each a proper proportion of lubricant without supplying it at the possible expense of the main bearings and without receiving an excess supply which might make a dirty engine.

Points About Cooling

From lubrication we pass to its obvious corollary, cooling. Considerable divergence of opinion still obtains among engine builders and radiator makers concerning water-cooling. The author is of opinion that, because increased flow of water would allow of the employment of a smaller radiator surface, that line of development is likely to be considered in the near future.

Another important matter concerns the rendering adjustable of the cooling capacity, or the surface, to suit variations of climatic conditions and of altitude. Assuredly, this is highly desirable. The conditions under which aircraft are being used to-day renders such a development well-nigh imperative. The use of radiators of relatively less size, such as is to be expected from speeding up the flow of water, should afford a notable advantage in this particular connection.

It is to note that air-cooling is coming into favor increasingly. The introduction of aluminum alloy in the manufacture of the cylinders has exercised a marked effect in regard to this tendency. It would appear that to date relatively very little has been done with multiple valves as applied to air-cooled engines. Yet in the matter of the advantages of employing multiple valves to the number of four per cylinder it would seem that the gains of this system as applied to water-cooled engines should obtain equally in the case of the air-cooled varieties. Further, the small valve is likely to give more satisfaction in air-cooled than in water-cooled engines by reason of the time factor in the conduction of the heat from the individual valve to the adjacent parts of the cylinder. For these reasons, among others, in the near future air-cooled engines of larger power may be expected to materialize. Certainly this type is very promising.

Carburetion at the Cross Roads

As applied to aircraft engines, the proposition of carburetion stands to-day somewhat on a basis of compromise. For this reason experiments now being carried out are directed toward obtaining more efficient and economical carburetion. The tests made on Sunbeam-Coatalen aircraft engines at the manufacturers' works at Wolverhampton have shown a fuel consumption of 0.65 pint per horsepower per hour, coupled with an oil consumption of 0.027 pint per horsepower per hour. It will be readily agreed that this stands for a distinct advance on consumption by engines using ordinary type carburetors so recently as at the beginning of the war.

Nevertheless, there is room for a deal of improvement yet. Perhaps this is not so much from the maker's point of view as from the pilot's. One refers more particularly to the supply of fuel to the carburetor itself, for instance, when the aircraft is rising rapidly or stalling. In the case of military aircraft, particularly, there arises the problem of carburetion while the attitude of the engine is being varied in all manner of directions owing to the maneuvering necessary while fighting an enemy.

When this war began there was relatively little fighting in the air, and the average flying was done at anything from 4000 to 6000 ft. To-day our airmen rarely go over the lines at less than 16,000 ft., and fighting has taken place certainly at altitudes of 21,000 and 22,000 ft. Accordingly it will be realized that at the outset of the campaign the problem of altitude was not thrust to such an extent on the attention of the designer and the manufacturer because such modest heights were deemed sufficient for aerial reconnaissance and other work, whereas in the interval it has become imperative to navigate the air at such vastly increased heights that the difference in atmospheric pressure can be ignored no longer for the sufficient reason that the altitudes in question could neither be attained nor maintained if the problems presented had not been solved, at least in part, already. They concern both carburetion and engine compression, as well as the matter of cooling. As to carburetion, the influence of altitude is quite the most important matter now engaging the attention of designers.

In dealing with the situation the correct line of attack would seem to lie in the direction of forced induction, though under present conditions perhaps it were unwise to state the manner in which experiments are being carried out toward this end. Suffice it that the problem is abundantly obvious and that great alterations in design are to be expected. Doubtless they will mark yet another point of very great divergence of design from that employed for engines for car service. It is beyond dispute that in the near future the two types must become more and more pronouncedly contrasted.

High Altitude a Factor

The alleged method of increased compression exploited for Zeppelin service as a means of tackling this problem is peculiarly suitable for airships owing to it not being necessary for those craft to climb by mere engine power, also to the fact that a major part of their work is done at high altitude. It is possible that the engines in which small change in atmospheric pressure is allowed for are used entirely for work at high altitudes, and have a much higher compression than those which are employed for maneuvering Zeppelins near the ground.

Of course, this question of compression is interconnected with the problem of carburetion; hence we must also regard altitude as a governing factor in the design of the latter-day aircraft engine. In the last few years considerable advance has been made in the degree of compression standardized successfully. Thus engines with a compression ratio as high as 6 to 1 are running satisfactorily at sea-level to-day. That, however, has been rendered possible only by evolving such a combination of features as valves of suitable design, diameters and openings, and by going very scientifically into the matter of cylinder head design.

Three Years' Progress

Assuredly it is interesting to compare present-day achievement with results of, say, three years ago, as instance those obtained at the Naval and Military Aeroplane Engine Competition in 1914. As a result, it will be found that then the use of aluminum was practically confined to the crank case only. Its application to the construction of pistons and other

small parts of the aircraft engine was not known. Further, we find that the maximum mean effective pressure was approximately 106.5 lb. per square inch, and that the average fuel consumption was 0.75 pint per horsepower per hour. The weight of the engine with fuel for a run of six hours' duration varied from 9.55 in the case of the rotary air-cooled variety to 11.27 in that of the vertical water-cooled type.

Fuel Consumption Reduced

By contrast, to-day the mean effective pressure standardized has been increased to 135 lb. per square inch, measured from the brake horsepower and, in some cases, actually through the reduction gear. At the same time fuel consumption has been reduced to 0.65 pint per horsepower per hour, while the weight of the V-type water-cooled engine has been brought down to 5.3 lb. per horsepower per hour with fuel and oil for a six hours' effort, all of which I hold to represent a notable rate of progress achieved in the brief period of less than three years.

Method of Rating

From the inception of the movement several methods have been proposed for rating gasoline engines. At the stage at which we have now arrived in constructing power plant for aircraft service some figure seems to be needed which will give a notion of the efficiency, or power output, of an engine in relation to its size. To-day the mean pressure is used often for this purpose; but in my view that is neither convenient nor can it be arrived at easily.

For this reason I wish to propose that the horsepower per unit piston displacement obtained from any given engine be taken as the standard for preparing the different "duties" of engines. Of course, the figure obtained is proportionate to the mean effective pressure, but doubtless it will be agreed that it is more convenient.

The displacement taken would be the displacement per cylinder multiplied by the number of cylinders and by the number of complete cycles per minute, but to serve the aim in view the horsepower per litre engine capacity per 1000 cycles, otherwise per 2000 crankshaft revolutions a minute, is proposed.

High-Speed Engines Gain in Marine Work

(Continued from page 1255)

The engine installed in this is the patrol model Duesenberg eight-cylinder, 6 $\frac{3}{4}$ by 7 $\frac{3}{4}$ in., with the cylinders cast in pairs. The valves are horizontal and mounted in a row, two to each cylinder. The inlets are toward the center of the block, cored to one opening, and the exhaust toward the end block with individual outlets on the top. The valve action is by means of vertical rocker arms fitted with rollers in the lower end of the camshaft, and with an adjusting screw at the upper end where the valve is engaged. These engines develop 400 hp. at 1500 r.p.m.

The crankshaft is hammer-forged alloy steel, 2 $\frac{3}{4}$ in. diameter, with the flywheel

flange integral. There are five main bearings, the front 6 in. long, the intermediate 4 in. long, and the rear 7 in. The bearings are hung from the crankcase in the usual manner and through-bolted from the cylinders. The bearing caps are cast steel and webbed, the main bearings being lubricated through cored passages in the crankcase. The camshaft is an integral type made from low carbon steel; namely, 0.15. It is manufactured in two pieces, which are bolted together and secured to the camshaft driving gear by a taper key-seated coupling.

This same engine is used on patrol boats, which have been stated to be acceptable to the United States Navy De-

partment, and of which the S. P. 54, owned and commanded by Herman Oerlichs, for whom it was built by George Lawley, is an example. It is equipped with two of the eight-cylinder patrol Duesenbergs.

The S. P. 54 is 63 ft. long, 12 ft. 6 in. beam, and 3 ft. 9 in. draft, with the engines operating at 1225 r.p.m., and developing 350 hp. each at that speed. The boat has a speed of 22.5 knots per hr. and is equipped with a wireless outfit and a Sperry Gyroscope Stabilizer. It is this type of boat which will be built in large quantities during the course of the war and which will demand the utmost in high-speed marine power plants.

Detail Specifications of Well-Known Motor Boat Types

Name of Boat	Type	Length	Beam	Draft	Engine	Cyls.	Bore	Stroke	R.P.M.	H.P.	Dia.	Pitch
Miss Minneapolis	Hydro.	20'	6'	....	Sterling	8	5 $\frac{1}{2}$ "	6 $\frac{3}{4}$ "	1500	275	..	..
Miss Miami	Hydro.	22'	6' 10"	....	Curtiss	12	5"	7"	1400	250	..	..
Hand's Countess	Displ.	40'	8' 6"	2' 5"	Van Blerck	8	6"	6"	1500	215	21-22	28-30
Sophia II	Displ.	40' 5"	9' 2"	3'	Sterling	8	5 $\frac{1}{2}$ "	6 $\frac{3}{4}$ "	1400	200	..	..
Raven III	Displ.	50'	9'	3' 6"	Speedway	8	5 $\frac{3}{4}$ "	7"	1200	200	22	32
Shadow III	Displ.	40'	9'	3' 6"	Speedway	8	5 $\frac{3}{4}$ "	7"	1200	200	22	32
Marycel	Displ.	35'	7' 6"	3' 4"	Duesenberg	8	6 $\frac{1}{4}$ "	7 $\frac{3}{4}$ "	1500	400	26	34
Government Barge	Displ.	35'	7' 6"	3' 4"	{ Van Blerck	6	6"	6"	1450	160	24	24
					{ Sterling	6	5 $\frac{1}{2}$ "	6 $\frac{3}{4}$ "

The AUTOMOBILE

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W. I. Ralph, Vice-President

E. M. Corey, Treasurer

A. B. Swetland, General Manager

231-241 West 39th Street, New York City

BUSINESS DEPARTMENT

Harry Tipper, Manager

EDITORIAL

David Beecroft, Directing Editor

Donald McLeod Lay A. Ludlow Clayden
Sydney Oxberry P. M. Heldt
J. Edward Schipper, Special Representative, Detroit

BRANCH OFFICES

Chicago—Mallers Bldg., 59 East Madison St., Phone Randolph 6960

Detroit—95 Fort Street, West, Phone Main 1351

Cleveland—516-517 Swetland Bldg., Phone Prospect 167

Cable Address Autoland, New York
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The Automobile is a consolidation of The Automobile (monthly) and the Motor Review (weekly), May, 1902, Dealer and Repairman (monthly), October, 1903, and the Automobile Magazine (monthly), July, 1907.

Automotive Unity

THE foresight of those who a year ago suggested changing the name of the Society of Automobile Engineers to Society of Automotive Engineers, and enlarging the scope of the society to include engineering practice in aviation tractors, motor boats, stationary gas engines and other lines, was conclusively proven at the annual summer meeting. The attendance, the largest in the history of the society, was truly representative of all branches. The meeting could no longer be looked upon as one of automobile engineers. There were aviation engineers in great numbers; tractor engineers were present in numbers; others representing the stationary gas engine field were on hand; in fact, it was truly an automotive engineering conference, and was a satisfying indication of the interest shown.

The meeting suggested the broad spirit of co-operation by combining of different engineering fields rather than segregation. This spirit of co-operation has dominated business for 10 to 15 years and it is only a natural development to come in such a profession as engineering related to various lines. No better proof of the growth and usefulness of the S. A. E. could be asked for than this work of co-operation and broadening. It is placing the bounds of the society in their rational position and embracing those activities which come together not only in an engineering sense but in a manufacturing and merchandising one as well.

Government and S. A. E.

ONE feature stands out as one of the most important lessons carried away from the 2-day session of the Society of Automotive Engineers at Washington. It is the fact that the meeting established a tangible connection between the Government and the society. It was the culmination of months of co-operation which has been going on since the early stages in the realization that it is necessary for America to use its resources of brains as well as of natural advantages.

To be concrete the engineers came away from the meeting with a definite knowledge of how each individual fitted in as a cog in the great machinery which the Government has set in motion in connection with the war. The papers which dealt with the construction of the submarine chaser and those which dealt with the design and use of aircraft in war were far more important as educational papers than merely as an interesting review of accomplishment. After hearing these papers and the discussions that followed, every engineer has been made aware how he can be of assistance to the Government.

Limits to Standardization

IN the very creditable endeavor of the Society of Automotive Engineers to standardize all parts of automotive apparatus that can be standardized to advantage, suggestions are occasionally made that meet with considerable opposition and are finally dropped. Sometimes it is found that practice pertaining to the part in question is in such a chaotic state and opinions vary so widely that it is impossible to agree as to what the standard should be. In other cases it seems questionable whether standardization will ever really be applicable to advantage. For instance, at this week's meeting it was attempted to standardize the location of the battery on passenger cars. There is no doubt that some locations on the chassis are better than others, and the discussion of the proposal brought out several points which cause battery trouble. For instance, if the battery is so located that all of the hot air discharged from the motor space passes over and around it, the electrolyte evaporates rapidly and must be replenished frequently. On the other hand, placing the battery too far toward the rear makes the connections long and increases the wire losses and the drop in voltage.

What makes standardization of battery location undesirable is that the best location depends to a certain extent upon the design of the chassis. The proper aspect of the problem is that the best of the several available spaces on the chassis must be chosen, rather than the battery location fixed in advance and the chassis designed around it.

Fortunately, with the organization of the standards work of the Society, by which every proposed standard must be passed successively by a division, the standards committee, the Society general meeting and the whole membership by letter ballot, it is practically impossible for any undesirable or defective standards to be placed on the books.

News of the Automotive Industry

Nine Buick Models for 1918

Passenger and Light Commercial Types—Differences in Bodies and Equipment

FLINT, MICH., June 27—The Buick Motor Co., in addition to the model E 6-49 described in last week's issue of **THE AUTOMOBILE**, will turn out eight other models for 1918, details of which have just been announced. These include model E 6-44, a three-passenger roadster; model E 6-45, a five-passenger touring car with dull finish, black leather upholstery, buttonless cushions, a special one-man top, and a rain vision, ventilating type windshield; model E 6-46 and model E 6-47, which are upholstered in automobile cloth and have convertible stationary tops and three-piece, storm-proof, ventilating type windshields.

Models E 6-44, E 6-45 and E 6-47 have 18-in. steering wheels, left drive, a semi-reversible split nut and worm type steering gear, a 118-in. wheelbase and 34 by 4 straight side tires, non-skid in the rear. Models E 6-44 and E 6-45 are listed at \$1,265; E 6-46 at \$1,695; E 6-47 at \$1,795. All the above models have semi-elliptic front springs and floating cantilever rear springs.

Model E 6-50 is a seven-passenger touring sedan with permanent top and disappearing glass side panels, upholstered with high-grade automobile cloth. It has a 124 in. wheelbase, straight side tires, non-skid in the rear, a 19 in. steering wheel and the same spring equipment as the other models, but with shock absorbers in front. A special one-man top with full back and gypsy curtains is fitted, as is a three-piece storm proof ventilating windshield.

Models E 4-32, a two-passenger roadster, and E 4-34, a five-passenger touring car, sell at \$795 each. These have 106 in. wheelbase and 31 by 4 in. clincher, non-skid tires. A unit power plant is fitted with three point support on the main frame. The engine has four 3% by 4% in. cylinders. Lubrication, carburetor, ignition, starter, transmission, drive, brakes, wheels and frame are the same as on model E 6-49 described last week. The clutch is a leather faced cone with expanders under the leather. The rear axle is of three-quarter floating type, and fitted with roller bearings and ball thrust bearings. The steering gear is of the semi-reversible split nut and worm type with 16-in. wheel. Extra long flat semi-elliptic springs are used both in front and rear. A special one-

man type of top clamps directly to the windshield when extended. The standard equipment includes a ventilating, slanting design windshield, double bulb headlights, electric tail and instrument lamps, speedometer, electric horn, tire carrier with extra demountable rim and complete tool equipment.

Model E 4 is a light delivery wagon with a Buick 3% by 4% in. valve-in-head engine, and sells at \$790, with an open express type body, canopy top and side curtains. It has a loading space of 42% by 70 in. and a carrying capacity of 500 lb. The body is finished in dark green, while the fittings, hood, radiator, fenders, skirt, wheels and chassis are black. The wheelbase is 106 in. Thirty-five brake horsepower is claimed for the engine. The rear axle is of the three-quarter floating type. Tires are 31 by 4 in. clincher, non-skid. Cooling system, lubrication, carburetor, ignition, starter, clutch, transmission, control, drive, brakes, etc., are the same as on model E 4-34.

N. G. E. A. Affiliates with S. A. E.

CHICAGO, ILL., June 21—The National Gas Engine Assn. voted to affiliate with the Society of Automotive Engineers as regards all engineering matters. This action followed the annual meeting of the National Gas Engine Assn. in Chicago.

Springfield Body to Reorganize

DETROIT, June 27—Directors of the Springfield Body Corp. meet in New York to-morrow to reorganize the company. Walter Fry, president, and Earl McGookin, sales and advertising manager, have tendered their resignations. A stockholders' meeting is to be held in New York July 3.

The company is in difficulties because it paid \$1,000,000 of its capital into the new building at Springwells instead of taking this from profits as they accrued. In addition the building cost 25 per cent more than was anticipated. Besides this, business has been very slow for several months. The company now has \$2,700,000 worth of orders on its books from Oakland, Studebaker, Cole and Reo. No creditors' settlements have been made yet.

Gasoline Exports 290,372,215 Gal.

NEW YORK, June 23—Gasoline exports in the 9 months ending March, 1917, totaled 290,372,215 gal., an increase of 81,138,286 gal., as compared with the period ending March, 1916, when the total was 209,233,929. Special precautions were taken to guard gasoline shipments from submarines.

Pierce Truck to Specifications

Government Requirements Met Exactly in New Model for Army Work

BUFFALO, N. Y., June 25—The Pierce-Arrow army truck, built to conform exactly with the War Department specifications, is being assembled at the plant of the Pierce-Arrow Motor Car Corp., the engine being now on the block. It is hoped to have the truck on the road by the end of the week.

John Younger, chief engineer of the truck department, states that the specification has worked out extremely well, and that he considers the truck to be nearly perfect for military work, though, of course, too powerful for its size for commercial purposes.

It is understood that the Pierce-Arrow company does not plan to build this truck for other than military work, but that it is prepared to produce any quantity that the government may call for, if necessary turning over the major portion of the plant available for truck manufacture.

Contracts for 20,000 Motor Trucks

WASHINGTON, June 27—Within a few days contracts for from 18,000 to 20,000 motor trucks will be awarded by the Quartermaster's Department under bids recently submitted to Col. Knisheen at Chicago. Major Drake, in charge of purchases, stated that while awards of contracts had not yet been formally made, it is understood that recommendations as to purchases have been sent to the higher authorities for formal approval. It was also stated at the War Department that any differences which might have existed as to specifications have been cleared up and that the Government will purchase trucks, relying upon the makers to go as far as they possibly can in standardizing smaller parts. The trucks for which contracts are now going out will be distributed among the makers to the extent that they can handle them as a general proposition.

Ford Building Tire Plant

DETROIT, June 25—Included in the various buildings being erected at the River Rouge by Henry Ford will be a very large unit devoted to tire manufacturing. Tires made in this factory will be manufactured exclusively for Ford cars.

Coal Is Paralyzing Industry

Federal Trade Commission Reports Railroads Are Large-ly To Blame for Shortage

WASHINGTON, June 23—The Federal Trade Commission believes that the coal industry is paralyzing the industries of the country, and that the coal industry itself is paralyzed by the failure of transportation. The commission states, in its report on the recent investigation of the coal industry, that the coal problem cannot be worked out so long as the railroads are permitted to divide and allot traffic; to lay embargoes without regard to their immediate effect upon industry or upon the systematic distribution of coal; to give priority to the movement of high-freight rate commodities, and to use the device of "long haul."

Production of Bituminous Limited

The present production of bituminous coal, the country over, is about 40 per cent short of the possible maximum, and this limitation is solely to be charged, as to primary cause, to faulty rail transportation. The present demand for coal is unprecedented, but the mines now open are capable of filling this demand if adequate car supply is furnished.

Mine labor, according to the commission, is being disorganized by reason of irregular employment and forced idleness, and that in some fields bituminous mines are working only 3 or 4 days a week, and that willing labor and willing operators are standing idle half the time.

The present balance of transportation is a great reduction in the proportion of the cars furnished for the transportation of coal. The railroads, however, are consuming their full quota of coal, so that while under favorable and natural conditions 35 tons of coal would be moved, out of each 100 tons of freight, there is now being moved very much less coal. The entire coal shortage is thrown upon the industries of the country and the domestic users, who, instead of having a coal supply equal to two-thirds of the total coal movement, are reduced to a small and continually diminishing ratio, and this in a time when every effort is being made to stimulate the industrial effectiveness of the nation.

Price of Coal Increased

The prices of coal to railroads and other large consumers have generally increased from 100 to 150 per cent, while prices to small consumers have often increased as much as 200 to 400 per cent, and in some cases even more.

During the first 2 months of the coal year of 1917 (April and May) there has been an increase in the production of anthracite of 2,433,000 tons as compared with the first 2 months of the coal year of 1916. This is an increase of 24 per cent, and should have been translated

into a distinctly favorable condition of the market.

Though the anthracite market has been filled with a supply which should be adequate for its normal use, the acute shortage of supply in bituminous and in coke, together with faulty distribution and speculation, have driven bituminous and coke prices up to a point which has put anthracite into competition with the other two forms of fuel.

The close supervision of anthracite thus fails of a remedy so long as bituminous runs wild, and the commission's plan as to anthracite cannot be extended over the bituminous industry because of the wide field and the great variation in conditions.

Chandler Shipments Increase

CLEVELAND, June 25—Shipments of Chandler car during May showed a drop of 718 as compared with April, the final week, which included a holiday recording the lowest shipments for months, 314.

There has been a rebound in business, however, since the first shock of war and shipments have almost reached the high levels of early April, as indicated in the following table:

Weekly average March 19-April 28.....	574
Week ending May 5.....	502
Week ending May 12.....	365
Week ending May 19.....	370
Week ending May 26.....	363
Week ending June 2.....	314
Week ending June 9.....	445
Week ending June 16.....	548

Parts Makers and Truck Engineers Confer on Standards

WASHINGTON, June 27—An informal meeting of about fifty truck parts makers and truck engineers was held at the bureau of standards this morning and consisted mainly of explanations as to just what is being attempted in army truck standardization, as outlined in an article on another page of this issue. John Younger suggested that standardizations should be carried to the utmost limit while the committees are about it. There was expressed a strong desire that these meetings be made more formal, that the whole committee and the whole society be advised of what is being done in order to get the widest co-operation.

Many present obviously felt that things were being done under cover. H. L. Horning, who was in the chair, explained that this was entirely mistaken; the informality was a result of doing the work the war department required with the utmost speed. It was eventually decided to break up the meeting into sections which immediately convened for discussion of engines, transmissions, axles, radiators, etc. Probably a meeting of a more formal sort will be held in the Middle West within 2 weeks, at which time absolute finality should be reached. It was decided that the truck standard division and perhaps some other chassis builders should have the findings of the sectional committees submitted because it was generally agreed that interchangeable designs which would really fit could not be produced by parts committees working individually.

Export Shipments Controlled

President Wilson Assumes Authority Over Foreign Trade —Exports Council Named

WASHINGTON, D. C., June 25—President Wilson has signed an order authorizing the creation of an Exports Council, under the powers vested in him by the espionage law. He thus assumes authority and control over all exports to foreign countries. The Exports Council will be merely advisory to the President, and there will be no prohibition of the normal flow of exports.

The President, however, has the authority of determining what this nation or that shall have of the products of the United States, and can stop or regulate the export of grain or other commodities to any neutral country which permits any of its supply from America to reach Germany.

The United States Government will have twenty agents in the European countries who will aid in determining the quantities of our products which each of the allied or neutral countries need, and to make full reports concerning conditions abroad, which will aid in the guidance of the Exports Council.

The whole object of the council will be to direct exports in such a way that they will go first and by preference where they are most needed and most immediately needed, and temporarily to withhold them, if necessary, where they can best be spared.

Secretary of State Lansing has been authorized to take such measures as may be necessary to administer and execute the President's order and to grant or refuse export licenses thereunder, in accordance with those instructions.

Weed Chains Sold Only to Jobbers at Net Price

NEW YORK, June 25—The American Chain Co., Bridgeport, maker of Weed non-skid chains, has abandoned all lists and discounts and henceforth will sell at net price. This announcement will be of much interest to the automobile trade, as it completely reverses the old form of contract in which Weed chains were sold under prices governed by the company.

Under the new policy, the company will sell only to jobbers. The Weed chain company is now compiling a list of accessory jobbers that will qualify under its interpretation of that title.

For the present Weed chain net prices will remain unchanged. The question has arisen that there may be a demoralization of chain prices as a result of the new policy. It is stated, however, that this is barely possible on account of the large demand for the product and the inability of the company to keep up with its orders. The scarcity in chains and the upward trend of prices it is thought will keep prices up.

Marmon To Make Aero Engines

U. S. Orders 1000 for Training Purposes—To Be Delivered in 90 Days

INDIANAPOLIS, June 23—The Nordyke & Marmon Co. expects to manufacture approximately 1000 airplane engines for the United States Government within the next 90 days. Within 60 days the company will occupy a new addition to its plant, which will be 100 by 350 ft. Another building of the same size will be completed in 90 days. Pending the completion of these improvements, the company is proceeding with the manufacture of engines on a large scale. The engines are to be used in airplanes that are to be sent to training camps in the Middle West.

All Ambulance Assembly at Kentucky Wagon Plant

LOUISVILLE, Ky., June 23—All motor ambulances hereafter bought for the United States Army will be assembled at the Kentucky Wagon Mfg. Co., Louisville. The contract between the Government and the Louisville concern covers a period of years and specifies several thousand cars per annum.

The parts of the ambulances, made by many factories, will be shipped to Louisville for assembling. The work will require the employment of scores of expert mechanics, in addition to those already connected with the Kentucky Wagon company.

Charges Ford With Favoritism

CHICAGO, June 26—The American Motor Car Co., which was formed this year to distribute Ford cars, filed suit yesterday in the United States District Court of the Northern District of Illinois for \$50,000 damages against the Ford Motor Co., of Detroit. It sets forth in its bill that it expended large sums of money to equip a sales office in Chicago to handle Ford cars, and alleges that the Ford company "arbitrarily and without reasonable cause" refused to deliver cars in pursuance of the contract. The attorney for the plaintiff charges favoritism on the part of the Ford company, and declares he personally knows certain dealers are given preference where Ford has not been able to deliver as fast as dealers have taken orders.

Atlas Specialty Wins Cover Suit

CHICAGO, June 23—The Atlas Specialty Mfg. Co. has won the suit brought against it by the Hobbs Patent Co. in the District Court of the United States for the northern district of Illinois, eastern division, Nov. 22, 1915, for infringing on its patent No. 901,616, covering radiator and hood covers. Judge Carpenter on Oct. 23, 1916, decreed the Hobbs patent void for want of patent-

able novelty. This decision was appealed only to be sustained. The Hobbs company then filed a brief for rehearing with the result that the Court of Appeals' decision was affirmed and the suit settled in favor of the Atlas company.

Goodyear Fights Railroad Rates

WASHINGTON, June 24—The Goodyear Tire & Rubber Co., Akron, has filed complaint with the Interstate Commerce Commission against the Akron, Canton & Youngstown Railroad Co. and other railways, protesting the increased rates on pack rubber or gum compound which these roads have put into effect. The complaint charges that the increase is a violation of the act, and unduly discriminatory, in that this increase would single out the rates from Akron to all points in territory of the official classification, and between other points in official classification territory.

It is asked that the commission require rates which have been in effect for years to be restored, and reparation in the judgment of the commission awarded.

New Aircraft Built

GRAND RAPIDS, MICH., June 26—G. L. McCarthy, a local engineer, is building a midget pusher biplane in collaboration with R. J. Hofmann which will have a new type motor weighing less than 65 lb. yet developing 28 hp. The entire plane when completed will weigh only 230 lb., but according to Mr. McCarthy will stand a stress of 1600 lb. Wind resistance is reduced by the use of a fuselage for the driver. The plane will be ready for its initial flight within a few days.

Paige to Advance Prices July 15

DETROIT, June 25—The Paige-Detroit Motor Car Co. will advance prices on its various models on July 15. Definite announcement of the various increases will be made shortly.

Designs of Allen Chassis Combined With Smith Form-A-Truck

BOSTON, June 9—John L. Judd, who has the New England agency for the Allen, Auburn and Smith Form-A-Truck, has just secured the entire United States territory for a new combination 2½-ton truck to be made on Allen chassis and Smith Form-A-Truck unit. Mr. Judd conceived the idea that there would be a demand for a larger truck than the Ford supplies, and as he had the Allen agency with the Smith he designed a new truck and then put it up to the two companies. They accepted it.

Federal Truck Prices Increased

DETROIT, June 26—The Federal Motor Truck Co. has increased the prices of its models as follows: 2-ton, \$150 increase; 1½-ton, \$100 increase; 2-ton and 3½-ton, each \$150, effective at once.

1000 Plane Order for Curtiss

New Buildings at Toledo to Cost Over \$1,000,000—Overland Airplanes

TOLEDO, June 22—Orders for 1000 battle planes received by the Curtiss Aeroplane Co. will speed up work at the branch factory of the Willys-Overland Co., which is devoting its activities to airplane manufacture. Buildings will be erected in connection with the airplane business in this city to cost more than \$1,000,000. Although complete planes will be built in Toledo with the establishment of a branch Curtiss factory in West Toledo, President John North Willys, of the Willys-Overland Co., stated that they might not be given field tests here. "The engines," he said, "are given a severe block test."

U. S. Flying Field for Belleville

WASHINGTON, June 23—The Signal Corps announces the letting of the contract for the fourth of the new government flying fields, to be built at Belleville, Ill., 23 miles from East St. Louis. It will be a standard two squadron field, accommodating 300 student flyers, with the requisite number of officer instructors, mechanics and enlisted men, and providing hangars for seventy-two training planes. Construction of the buildings and the preparation of the field will begin immediately.

Other Fields Planned

The location of the fields already announced are Dayton, Ohio; Mt. Clemens, near Detroit, Mich., and Rantoul, near Champaign, Ill. The Government's present plans contemplate letting the fifth contract in about 2 weeks, and the remaining four of the nine fields already authorized at successive intervals of 2 weeks thereafter.

The preparation of the three fields already started has been made an emergency job, and the Chanute Field, at Champaign, is already nearly done. Substantial progress has also been made on the big four-squadron Wilbur Wright Field at Dayton, and the Selfridge Field at Mt. Clemens, Detroit. The authorities hope to have men flying on all three of these fields by the middle of the summer.

Pay \$1,000,000 for Tractor Patents

JACKSON, MICH., June 26—The H. M. Leonard Tractor Co., capital \$1,500,000, will soon explain its capitalization to the State Securities Commission. According to the incorporation papers of the new company which took over the L. M. H. Investment Co. of Lansing, Mich., it is to pay the old company \$1,000,000 for the patents on a tractor which H. M. Leonard invented.

LANSING, MICH., June 26—The Lansing Body Co. is manufacturing ambulance bodies for the Government.

Joy Field Opens July 5

Known as Selfridge Field—
900 Aviation Students Will
Be Accommodated

MT. CLEMENS, MICH., June 23—The Joy Aviation Field, which was recently sold to the Government, as reported by THE AUTOMOBILE, will be known officially as Selfridge Field, and will be ready for aviation work by July 5.

The field will be a replica of the others which are now being constructed throughout the country. It is a 600-acre field and contains 160 acres of timber land, which is being cleared and will be converted to construct corduroy roads over the surrounding grounds.

Work has been in progress for a short time and there are now in course of construction twelve hangars, two aero repair shops, six officers' quarters, six non-commissioned officers' quarters, school buildings, hospital, power house, six barracks, four latrines, quartermaster's supply department, aerial supply depot, and machine shops.

The field will be a complete city with grading, sewerage systems, heating and lighting plants, school houses for the children of its occupants, and so forth.

When in full operation 900 students will be accommodated. The field is named in honor of the late Lieutenant Thomas N. Selfridge, the first United States navy or army officer killed while flying.

The chief test for students applying for the aviation course is for perfect balance, which is determined by examining physicians who investigate the amount of fluid in certain ducts in each side of the head.

Wagner-Hoyt To Leave Field

NEW YORK, June 25—The Wagner-Hoyt Electric Co., organized in June,

1916, has gone into bankruptcy. All of its merchandise, fixtures and machinery will be sold at public auction at the factory and salesroom, 1902 Broadway, July 2. The sale will be held under the supervision of the Supreme Court of New York.

The company was organized to manufacture complete electrical equipment for automobiles and market it as a unit. A. F. Wagner, formerly president of the Wagner Specialties Co., and Frank Hoyt, formerly chief engineer of the Simms Magneto Co., together with Gerald Laugh, formerly connected with the Burroughs Adding Machine companies, were the incorporators. Mr. Wagner was president and general manager, Mr. Hoyt treasurer and chief engineer, and Mr. Laugh secretary.

The concern obtained a license under the patents of the late H. Ward Leonard covering the control of electric lighting systems on automobiles, and in addition to producing the complete electrical equipment of a car, including starting and lighting, ignition and lamps, also marketed a new type of storage battery.

Ford Gives \$500,000 in Ambulances

DETROIT, June 22—The Ford Motor Co. has given 1000 Ford ambulances valued at \$500,000 to the American Red Cross.

Kuckuk Offers F. W. D. Ambulance

MILWAUKEE, WIS., June 9—Anton Kuckuk, a director of the Four Wheel Drive Auto Co., Clintonville, Wis., and a member of the Wisconsin Senate, now in session at Madison, has made an offer to the Second Field Hospital, Wisconsin National Guard, with base at Madison, of a 3-ton F. W. D. truck, completely equipped, and valued at about \$4,500, on condition that the people of Madison and vicinity will provide two additional trucks necessary for fitting out the hospital corps.

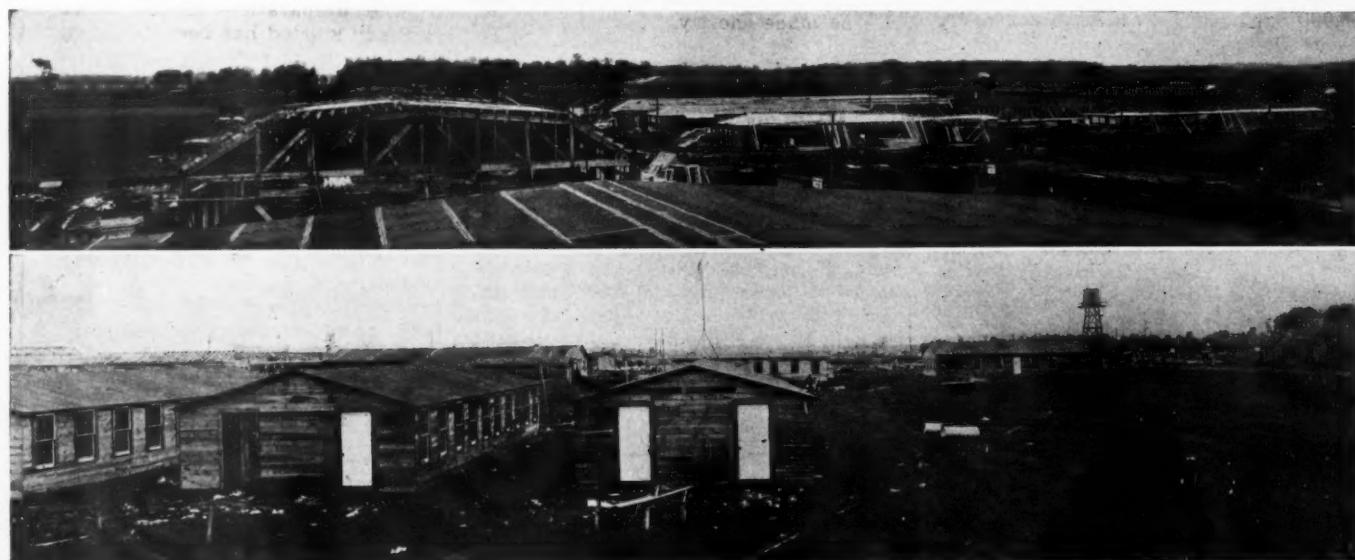
Drexel Plans To Reorganize

To Bring Out 8-Cylinder Car
Selling at \$1,295—
A. J. Farmer Out

CHICAGO, June 26—Affairs of the Drexel Motor Car Corp., implicated by the failure of two south side Chicago banks, and which seemed about to be smoothed out, reached a state of chaos in a stockholders' meeting held last Sunday, with the result that a new company is to be formed to take over the Drexel. It will have an entirely new official personnel and will bring out a new car equipped with an eight-cylinder Ferro engine instead of the sixteen-valve engine formerly used. The new car will sell at a price around \$1,295.

Two weeks ago Judge Carpenter, in the Federal Court, appointed a receiver for the Drexel Motor Car Corp. at the request of certain stockholders. In the meeting held last Sunday a new managing committee was appointed which will organize a new company, to be incorporated under the laws of Illinois for \$300,000, all of this stock to be absorbed by the present Drexel stockholders. This company will buy the assets of the old Drexel and continue operations. By forming a new corporation, a large amount of stock which it is said brought little, if any, revenue to the old company will be eliminated. There will be no stock which does not represent actual physical assets of the new concern.

Tests have been made with the Drexel car equipped with an eight-cylinder Ferro engine for several weeks, and the new company will go ahead with the Drexel production, using the Ferro engine, according to members of the committee now organizing the new company. A. J. Farmer, former president of the company, and officials of two de-



These photographs illustrate the transformation wrought in the Joy Aviation Field, now known officially as Selfridge Field, in honor of the late Lieutenant Thomas N. Selfridge, by the construction of hangars, aero repairshops, officers' quarters, etc. In the top picture are shown hangars in course of construction; in the lower picture are the new bunkhouses and machine shops

funct banks who held large blocks of stock in the Drexel Motor Car Corp., will have no connection with the new concern. Plans are under way for utilizing at least part of the factory for the manufacture of munitions. According to the committee's report last Sunday, \$350,000 was received from the sale of stock in the Drexel company. Having \$213,045 in material on hand and debts of \$106,070, leaves an equity of \$106,974 for the holders of \$1,300,000 par value of stock.

Bowser Liberty Loan Plan Success

FORT WAYNE, June 23—During the time subscriptions were being taken for the Liberty Loan, S. F. Bowser & Co. instituted a 2-day campaign of its own which was quite successful. The factory and officers were separately organized in various divisions. As a result, 91 per cent of the 1566 factory and office employees bought bonds to the amount of \$130,950.

Prest-O-Lite Employees Buy Bonds

INDIANAPOLIS, June 25—Employees of the Presto-O-Lite Co. have to date bought \$84,350 worth of Liberty Bonds. The company offered to pay its employees 1½ per cent interest on the Liberty Bonds they purchased in addition to the 3½ per cent paid by the Government. The bonus offer was limited to \$250 for any one person.

Peru Changes Automobile Customs Classification

LIMA, PERU, June 23—Motor vehicles intended for use as taxicabs are dutiable at 10 per cent ad valorem under the new tariff law. The customs officials have been holding that all closed cars are dutiable at 20 per cent ad valorem, but as a result of representations of the Commercial Attaché, W. F. Montavon, it was decided that the lower rate should be used because the vehicle is for public use. Open passenger cars are dutiable at 10 per cent ad valorem.

To Seek Foreign Trade

MILWAUKEE, WIS., June 18—The Merchants and Manufacturers' Assn. of Milwaukee, recently reorganized to accommodate a membership increased from 1400 to 4000 individuals and firms, has undertaken the organization of a foreign trade bureau which will seek business all over the world. The firms identified with the automobile industry which are represented on the special committee to carry out the plan include: Auto Parts Mfg. Co., Sterling Motor Truck Co., International Harvester Corp., A. O. Smith Corp., Stegeman Motor Car Co., Wadham's Oil Co., Wisconsin Motor Mfg. Co., Kempsmith Mfg. Co., Koban Motor Co., Evinrude Motor Co., Harley-Davidson Motor Co.

INDIANAPOLIS, June 23—Joseph Ward, branch manager of the United States Tire Co., has been appointed district manager of that company.

Farmers in Chile Want Cars

Opportunity for Truck Sales in Nitrate Fields—High Prices Have Hurt Sales

SANTIAGO, CHILE, June 20—Chile offers many opportunities for the sale of low and medium-priced automobiles, according to Federico H. Tonkin, of this city, who is now in New York to establish himself as a specialist in Chilean export and import business. The Chilean farmer has as yet to be reached, and it is thought that there should be a large demand for light cars from this source. The sale of American accessories is not as large as it should be, principally on account of the high prices. There is a good opportunity for the opening of an accessory store in this city for the exclusive sale of American accessories of all kinds.

The use of trucks in the nitrate business here to replace the carts now in use offers large opportunities for sales. The nitrate business has grown very rapidly. There are now 140 nitrate factories. In the nitrate country, in the north of Chile, the nitrate is blasted in large blocks from the earth and then must be transported to the crushers before it is boiled. At present much of this haulage is done on two-wheel carts and on small railroads.

The sale of automobiles could be much improved if the retailers would cut down on their prices. As with accessories, the feeling is general that frequently American cars are sold at too high prices. The greatest demand is for the five and seven-passenger touring cars. There is a limited demand for roadsters and sedans.

April is a good selling month in that it is the month after harvest and there is plenty of money. Because of this April, May and June may be classed as good selling months. October, November and December are also good months.

Santiago automobile sales in the last 2 years totaled 1800 cars. This city seems to be the best location for sales on account of its topography, which is spread out very much, and the wide and fairly good streets. Valparaiso, on the other hand, is surrounded by hills, and consequently offers fewer sales. Country roads throughout Chile are generally poor, but a commission has been appointed to promote the repair of roads throughout the country. At present gasoline is selling at 52 cents per gallon.

War Boosts Truck Sales

MINNEAPOLIS, June 23—War is accelerating the truck business in the Twin Cities. The E. G. Staude Truck Mfg. Co. recently completed a rush order amounting to \$85,000, sent by express to be delivered in London. All 120 employees turned in and in 29 hr. continuous work

had packed 500 Mak-A-Tractors, on which the express charges to the Atlantic seaboard were more than \$9,000. A steamship was held at port for the order.

Since Jan. 1 more than \$5,000,000 worth of tractors have been sent out for the Allied forces, or 1000 machines. The Emerson-Brantingham Co. shipped 300 to France, Russia and England and has contracts for as many more. The Gray Tractor Co. has shipped 150 tractors, and orders still are unfilled. The Bull Tractor Co. has sent out 250 machines and is making continuous shipments to England.

Six G. M. C. motor ambulances have been sold by B. E. Fawkes, distributor, to Minneapolis citizens, three for the local base unit hospital and three for the Norton-Harjes corps. Each car has special body and cost \$1,805.

India Licenses Imported Parts

CALCUTTA, INDIA, June 10—The customs officials in India are instructed to license importation of automobile accessories and parts, provided they are imported genuinely for the purpose of repair and not for assembling into new cars. There is no intention of placing any material restrictions on the importation of bona fide accessories, even if these go into stock, so long as they are apparently intended for assembling into new cars.

DIVIDENDS DECLARED

Ajax Rubber Co., special Red Cross of \$14,200, payable June 29, pro rata to stockholders of record of June 26.

General Motors Co., quarterly of 3 per cent on common and 1½ per cent on preferred, payable Aug. 1 to stock of July 14.

Chevrolet Motor Co., quarterly of 3 per cent, payable Aug. 1 to stock of record July 14.

The Detroit Steel Products Co. a semi-annual of 3½ per cent on preferred stock, payable July 2 to stock of record June 25.

Pfau Mfg. Co., quarterly of 1½ per cent on preferred of June 20, payable July 2.

General Motors Gives \$250,000

FLINT, MICH., June 22—The General Motors Co. yesterday voted \$10 to the Red Cross fund for every employee.

The Buick and Weston-Mott companies here will subscribe \$125,000. The Cadillac and Northway companies of Detroit will subscribe \$75,000; the Oakland and General Motors Truck companies of Pontiac, \$25,000; the Olds company of Lansing, \$15,000, and the Jackson-Church-Wilcox Co., Saginaw, \$10,000.

Westinghouse Red Cross Dividend

NEW YORK, June 22—At the regular meeting of the board of directors of the Westinghouse Electric & Mfg. Co., an extra dividend of ½ of 1 per cent on both common and preferred stock was declared for the benefit of the Red Cross

fund. This dividend which will amount to approximately \$375,000 is an addition to the regular quarterly of 1½ per cent on both common and preferred, which was also declared.

At this meeting the annual election of officers of the company was held.

Chairman of the board, Guy E. Tripp; president, E. M. Herr; vice-presidents, L. A. Osborne, Charles A. Terry, and H. P. Davis; acting vice-president, T. P. Gaylord; comptroller and secretary, James C. Bennett; assistant secretary, W. H. Jones; assistant treasurer and assistant secretary, S. H. Anderson; auditor, F. E. Craig, and assistant auditor, W. B. Covil, were re-elected to their respective offices. Three new vice-presidential offices were created and the following were elected to fill same: Henry D. Shute, and Herbert T. Herr, both of Pittsburgh, and Walter Cary of New York.

Chevrolet Gives \$100,000

NEW YORK, June 23—The Chevrolet Motor Co. has authorized a contribution of \$100,000 to the Red Cross war fund, to be subscribed by its several divisions at Flint, New York, Tarrytown, St. Louis, Bay City, Toledo, Fort Worth and Oakland, Cal.

G. E. Moves New York Offices

NEW YORK, June 23—The New York offices of the General Electric Co. have been moved from 30 Church Street to the Equitable building, 120 Broadway. The entire twentieth floor of the building has been especially arranged and furnished for the company. For 9 years these offices have been at 30 Church Street. The company's offices in New York are the largest and most important among its district offices.

Security Prices Are Steady

Chevrolet Active--Other Shares in Demand—Saxon Decline Attracts Attention

NEW YORK, June 27—General Motors, Chevrolet, Chandler and Willys-Overland issues featured this week's stock activities with substantial rises. The tone of the market was improved and it is believed that motor shares will be more and more in demand as Government orders for airplanes and engines come in.

The decline of the stock of the Saxon Motor Car Co. last week has excited considerable attention. The stock opened last Monday morning at 34 and closed Saturday morning at 19½. It had a low mark of 15. The decline is thought to be due in part by short selling preceding and following the action of the directors in deferring the dividend at a meeting during the week until July 24.

It is rumored that the company is planning some new financing. In February of this year the Saxon company suffered a severe setback through a fire which destroyed its leased plant and has put several hundred thousand dollars in earnings into the new plant at Springwells, Mich., which is now nearing completion. The company is said to be well stocked with a large supply of materials.

100% Stock Dividend for Detroit Iron & Steel Stockholders

DETROIT, June 23—The Detroit Iron & Steel Co. has declared a cash dividend of 1½ per cent on the company's pre-

ferred stock, payable July 16 to stockholders of record July 2. It has also declared a 10 per cent dividend in cash payable in four installments of 2½ per cent each to the owners of common stock. The first payment is to be July 16 to stockholders of record July 2. The company will increase its authorized common stock from \$750,000 to \$1,500,000 by transfer of \$750,000 from accumulated earnings, and that the new stock be issued to present owners of common stock in the form of a 100 per cent stock dividend. The new stock is to be issued July 2. When the operation is completed the company's outstanding capital stock will comprise \$750,000 of 7 per cent cumulative preferred and \$1,500,000 of common stock, both par value \$10. The company operates a large steel plant on Zug Island at the mouth of the River Rouge.

U. S. Rubber Acquires Rubber Goods Minority Stock

NEW YORK, June 23—The United States Rubber Co. has acquired the minority stock of the Rubber Goods Mfg. Co., thus solidifying its financial structure. This move will enable the company to take title to the physical property and all assets of the Rubber Goods company, and will consolidate into the parent company the entire tire and mechanical goods portions of its business.

The United States Rubber Co., at the end of 1915, owned all but \$1,532,300 of the \$27,293,100 preferred and common stocks of the Rubber Goods company. By the end of 1916 this amount had been further reduced to \$991,900. Now all of the minority stock has been purchased and the Rubber Goods company will have its capitalization reduced to some purely nominal figure like \$100,000.

Automobile Securities Quotations on the New York and Detroit Exchanges

	Bid	Asked	Net Ch'ge
*Ajax Rubber Co.	68½	71	..
J. I. Case T. M. Co., pfd.	80	84	-4
Chalmers Motor Co. com.	9	13	..
Chalmers Motor Co. pfd.	..	..	..
*Chandler Motor Car Co.	87	92	+4
Chevrolet Motor Co.	101	105	+6
Fisher Body Corp. com.	34	38	-1
Fisher Body Corp. pfd.	85	90	..
Fisk Rubber Co. com.	74	76	..
Fisk Rubber Co. 1st pfd.	103	106	..
Fisk Rubber Co. 2nd pfd.	92	95	..
Firestone Tire & Rubber Co. com.	115	122	-8
Firestone Tire & Rubber Co. pfd.	105	107	..
*General Motors Co. com.	118½	119½	+7½
General Motors Co. pfd.	88½	89	+1½
B. F. Goodrich Co. com.	51½	52½	-1½
B. F. Goodrich Co. pfd.	105½	108½	-1½
Goodyear Tire & Rubber Co. com.	180	85	-13
Goodyear Tire & Rubber Co. pfd.	105½	107	-½
Grant Motor Car Corp.	3	6	..
Hupp Motor Car Corp. com.	3	4	..
Hupp Motor Car Corp. pfd.	72	80	..
International Motor Co. com.	..	15	..
International Motor Co. 1st pfd.	..	60	..
International Motor Co. 2nd pfd.	..	30	..
*Kelly-Springfield Tire Co. com.	47½	48½	-1
*Kelly-Springfield Tire Co. 1st pfd.	89	95	+1½
Lee Rubber & Tire Corp.	18	19	-½
*Maxwell Motor Co., Inc., com.	49	49½	+½
*Maxwell Motor Co., Inc., 1st pfd.	66	67	+1
*Maxwell Motor Co., Inc., 2nd pfd.	30	31½	-1
Miller Rubber Co. com.	180	190	-5
Miller Rubber Co. pfd.	102	105	..
Packard Motor Car Co. com.	..	150	..
Packard Motor Car Co. pfd.	95	98	..
Paige-Detroit Motor Car Co.	29	31	..
Peerless Truck & Motor Corp.	16	18	..
Portage Rubber Co. com.	145	155	+5
Portage Rubber Co. pfd.	..	..	..
Regal Motor Car Co. pfd.	27	29	-1
*Saxon Motor Car Corp.	20	20½	-9

	Bid	Asked	Net Ch'ge
Springfield Body Corp. com.	52	57	..
Springfield Body Corp. pfd.	110	117	..
Standard Motor Construction Co.	11½	12½	-½
*Stewart-Warner Speed. Corp.	71	73	-3
*Studebaker Corp. com.	82½	82½	+3½
*Studebaker Corp. pfd.	98½	100	-2½
Swinehart Tire & Rubber Co.	65	70	..
United Motors Corp.	28½	28½	+1½
*U. S. Rubber Co. com.	61	61½	+1
*U. S. Rubber Co. pfd.	107	107½	-½
*White Motor Co. com.	46	48	..
*Willys-Overland Co. com.	34½	34½	+3½
*Willys-Overland Co. pfd.	92½	93½	-1½

*At close June 25, 1917. Listed New York Stock Exchange.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Auto Body Co.	..	29	..
Bower Roller Bearing Co.	..	39	..
Chevrolet Motor Co.	98	102	+7
Commerce Motor Car Co.	..	7½	..
Continental Motor Co. com.	..	..	..
Continental Motor Co. pfd.	..	27	..
Edmunds & Jones Co.	..	..	..
Ford Motor Co. of Canada.	22	25	+1
Hall Lamp Co.	..	..	..
Hayes Mfg. Co.	..	15	..
Michigan Stamping Co.	..	..	..
Motor Products	..	..	..
Packard Motor Car Co. com.	135	144	..
Packard Motor Car Co. pfd.	..	..	..
Paige-Detroit Motor Car Co.	29½	30	-½
Prudden Wheel Co.	22½	25½	+2½
Reo Motor Car Co.	28½	28½	-½

INACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Atlas Drop Forge Co.	38	41	..
Kelsey Wheel Co.	82	..	..
Regal Motor Car Co.	26½	..	..

Factory Activities

FLINT, MICH., June 22—All industries in the city of Flint, Mich., will operate the eastern time schedule during the months of July, August and September. The schedule will go into effect on July 1. The Buick Motor Car Co., the Chevrolet Motor Co., the Mason Motor Co., the Dort Motor Co., the Champion Ignition Co. and the Weston-Mott Co. will all operate according to the new schedule.

DETROIT, June 22—The Titan Motors Corp., organization of which was recently reported in THE AUTOMOBILE, has taken a portion of the Bour-Davis plant and placed a corps of draftsmen to work. A. A. Gloetner, of the company, who returned from Washington this week, has reported excellent progress, and states that an engine for trucks designed for the Government is to be manufactured at the Titan plant.

TULSA, OKLA., June 23—The Universal Motor Co. will build a four-story assembling plant, 140 by 150 ft.

CLEVELAND, June 23—The Peerless Motor Car Co. has completed extensions to be used for the manufacture of passenger cars, and has commenced the erection of a warehouse, 48 by 400 ft. The motor truck department of the company is employed to about its full capacity in trucks for England at the rate of fifteen a day.

CLEVELAND, June 23—The Templar Motors Corp. has commenced the erection of a one-story building, which will be the first unit of its plant. Manufacturing will commence in about 30 days.

RACINE, WIS., June 23—The Racine Auto Tire Co., organized in 1910 with a capital stock of \$500,000, has announced plans for the erection and equipment of a complete new tire and tube plant with a capacity of 7500 tires a day, and employing from 3000 to 4000 operatives. The present plant produces 400 tires a day and employs 150 men. Last fall the company purchased the former Racine baseball park property and is planning a five-story reinforced concrete and steel plant, 260 by 320 ft. Work will begin about Aug. 1, so that occupancy may be taken early in 1918. The Racine Auto Tire Co. features the Horseshoe tire and is distinct from a tire and rubber company of similar name in Racine.

CLEVELAND, OHIO, June 25—The K. D. Carbureter Co. has purchased a plot of ground 324 by 675 ft.

DETROIT, June 25—Work has been started on the construction of the large ore docks and blast furnaces which will be built on the River Rouge for Henry Ford. Several acres of ground have

been excavated and the work is being pushed rapidly.

BAY CITY, MICH., June 23—The Wilson Body Co.'s plant, construction of which recently started in this city, is being rushed to completion and will be ready for occupancy by Aug. 1.

DETROIT, June 25—A one-story warehouse is to be constructed at Holbrook and the Grand Trunk Railroad for the Denby Motor Truck Co.

DETROIT, June 25—A four-story factory building is to be erected for the Detroit Pressed Steel Co. Alterations are to be made upon three of its present plants.

INDIANAPOLIS, June 23—The Warner Gear Co., Muncie, Ind., will establish a grocery exclusively for employees.

ENID, OKLA., June 23—The Geronimo Motor Co. will build a factory 65 by 300 ft., with a 40 by 65-ft. wing.

TRAVERSE CITY, MICH., June 23—The Napoleon Motor Car Co., Napoleon, Ohio, it is stated, will locate its plant in this city. The company has been reorganized with a capital of \$150,000. The company will have an initial capacity of three cars a day. O. A. George, who has been the active head of the concern, will remain in that capacity.

Women Working in Factories

DETROIT, June 25—Planning to meet the labor shortage which will be produced by prolonged war, the automobile industry is beginning to regard women seriously for factory work. At present approximately 3000 women are being employed in the factory of the Chalmers Motor Co., the Aluminum Castings Co., Morgan & Wright, the Maxwell Motor Co. and the General Brass & Aluminum Co. The Chalmers Motor Co. is making a very extensive experiment and has placed women on drill presses, bench machines, milling machines, assembling machines and inspecting, and is also using them in the foundry. Various manufacturers, now figuring on the employment of women, contemplate placing them in such occupations as sorters, counters, inspectors, sweepers, cleaners, punch press operators, screw machine work, threading and tapping screws, bench assembling and core making.

DEALERS

\$4,000,000 Contract for Maxwell

DETROIT, June 25—The Maxwell Motor Sales Corp. has closed a contract with the John D. Williams Co., of New York, for 6000 Maxwells valued at

\$4,000,000. A large number of the cars will be shipped to points in South America and the remainder will go to countries in the Orient. The Williams company is one of the largest exporters and importers of automobiles in the United States.

Buick Dealers Convene at Chicago

DETROIT, June 26—Managers and distributors of thirty-six branches of the Buick Motor Co. in all parts of the United States, representing over 4000 Buick dealers, opened their annual meeting here yesterday. Addresses will be made by Walter P. Chrysler, president and general manager; H. H. Bassett, assistant general manager, and E. T. Strong, sales manager.

DETROIT, June 23—District sales managers and branch managers of the Hupp Motor Car Corp. are holding a semi-annual 3-day convention at the factory. They have been entertained by dinners and theater parties.

DETROIT, June 23—Robert L. Alvies has been made the Maxwell distributor for northern California. The name of Mr. Alvies' company is the Western Motors Co. The company contracted with the Maxwell Motor Co. for \$2,000,000 worth of Maxwells during the next 12 months.

DETROIT, June 20—The Doble-Detroit Steam Motors Co. has closed a contract with W. L. Hughson, president of the Pacific Kissel-Kar branch of San Francisco, for 1000 cars, and with the Sanders-Duffy Auto Co., of Fort Worth, Texas, for 500 cars.

FRESNO, CAL., June 20—The Willys-Overland Co. will erect a building at a cost of \$70,000 in this city for sales and service purposes.

NEW YORK, June 23—The Standard Woven Fabric Co., Walpole, Mass., has opened a local office at 1834 Broadway, in charge of Tom Howard.

NEW YORK, June 25—The Meridian Motors Co., Inc., distributor for Anderson cars, is moving from its temporary showrooms at 1690 Broadway to 1800 Broadway, the former showrooms of the Premier Motor Co.

STEVENS POINT, WIS., June 23—The Bukolt Mfg. Co., manufacturing Highway steel-shod tire protectors, has closed a contract with F. M. Buckel and J. T. Grady, Havre, Mont., to act as wholesale representative for the state of Montana. The Bukolt Co. is negotiating for similar arrangements in four eastern states.

Personals

TOLEDO, June 22—Harry L. Shepler, vice-president in charge of production of the Willys-Overland Co., will resign July 1. Mr. Shepler's plans for the future are not yet ready for announcement. He has wanted to resign from the Willys-Overland Co. for several months owing to his desire for a complete rest. Mr. Shepler has been associated with the automobile industry since its inception and has been connected with the Willys-Overland Co. since 1909, first as superintendent, then as general superintendent, and finally as vice-president in charge of production. He is one of the most important figures in the automobile industry.

W. H. Birchall, superintendent of the Willys-Overland Co. plants has been appointed general superintendent to succeed Mr. Shepler.

DETROIT, June 25—Carl Jeffries has been appointed chief engineer of the Detroit Truck Co. Mr. Jeffries was formerly with the Lozier, Studebaker and Reo companies. Harry Peirce has been appointed purchasing agent of the company. Mr. Peirce was formerly with the Regal Motor Car Co.

INDIANAPOLIS, June 23—C. E. Jeffers has been appointed chief engineer of the Nordyke & Marmon Co.

TOLEDO, June 23—William R. McCulla, of the engineering staff of Willys-Overland Co., is returning to England to again enter army duties.

FLINT, MICH., June 22—C. S. Mott, one of the directors of the General Motors Co., has been summoned to Washington by Howard E. Coffin to confer with the National Defense Council.

YORK, PA., June 22—Ralph E. Trout has resigned as director of purchases for the Pullman Motor Car Co., and has accepted a similar position with the Victor Motor Co., York.

DETROIT, June 22—H. H. Howe has been appointed sales manager of the Acason Motor Truck Co. Mr. Howe was formerly with the Maxwell Motor Co.

NEW YORK, June 23—R. T. Jollie, Jr., has been appointed supervisor of the Ajax Rubber Co. in Ohio, West Virginia and Kentucky.

DETROIT, June 23—M. L. Perry, formerly in the purchasing department of the Chalmers Motor Co., has been made sales manager of the C. A. S. Sales Co.

SYRACUSE, June 25—Robert H. La Porte, who has had a long connection with the Franklin Automobile Co. as a field representative, will set up for himself July 1 in Washington, D. C., as the

Franklin Motor Car Co. He will locate at 1324 Fourteenth Street. Mr. La Porte covered the East for the Franklin company for a number of years and then spent 2 years for the Scripps-Booth, returning to the Franklin people a few months ago.

DETROIT, June 23—William Lininger has been appointed a zone manager for the Chalmers Motor Co. Mr. Lininger was formerly assistant sales manager of the Mitchell Motor Co., Racine, Wis.

DETROIT, June 23—T. H. Smith has been appointed special representative for the Packard Motor Car Co. of New York. Mr. Smith was formerly a field representative for the Packard company.

MILWAUKEE, June 24—H. J. C. Henderson, for several years manager of the Chevrolet Motor Co. of Wisconsin, has resigned to become associated with the Frint Motor Car Co. as retail sales manager. The Frint company is Monroe and Oldsmobile distributor in Wisconsin and Upper Michigan. Mr. Henderson is succeeded as Chevrolet manager by M. D. Douglas.

FLINT, MICH., June 25—Morgan D. Douglas has been appointed manager of the Milwaukee retail sales of the Chevrolet Motor Co. Mr. Douglas was formerly with the Detroit branch of the Chevrolet Motor Co.

AKRON, June 23—W. A. Johnson has become office manager of the automobile tire department of the B. F. Goodrich Co. He was assistant to A. J. Wills, whom he succeeds. Mr. Wills retired to take up special duties and will be associated with H. C. Miller, director of tire sales. Mr. Johnson was at one time general sales and advertising manager of the Pierce Cycle Co., Buffalo.

CHICAGO, June 23—M. W. Hanks has resigned as local representative of the automobile equipment department of the Westinghouse Electric & Mfg. Co. to take up standardization work with the Society of Automotive Engineers. This district will be combined with and handled from Indianapolis by H. S. Johnson, with the title of western district representative.

CLEVELAND, June 25—H. Scott Johnston has become vice-president and general sales manager of the Grant Wire Wheel Co. Mr. Johnston was formerly general manager of the Crow-Elkhart Sales Co.

NEW YORK, June 25—E. M. Newald has joined the Commonwealth Finance Corp. as assistant to George McIntyre,

sales manager. Mr. Newald was formerly Chicago manager of new business of the Guaranty Banking Corp.

LONG ISLAND CITY, N. Y., June 25—Chas. Froesch, formerly chief draftsman for the Gillette Motors Co., Mishawaka, Ind., has become an inspector of United States airplanes and airplane engines in the Signal Service.

GRAND RAPIDS, MICH., June 25—Lette Shay has joined the Higrade Motors Co. as production manager and assistant treasurer.

NEW YORK, June 23—A. L. Godoy, for 2 years general manager of the Crow Motor Sales Co., has resigned and organized the Meridian Motors, Inc., to handle the Anderson car in the Metropolitan territory. V. Vivaudou is president and James A. MacDonald is vice-president.

MEETINGS AND ELECTIONS

NEW YORK, June 23—At the organization meeting of the board of directors of the Stutz Motor Car Co. officers for the ensuing year were re-elected, with the substitution of W. N. Thompson as treasurer, who takes the place of G. H. Saylor, resigned. An executive committee was selected, composed of Harry C. Stutz, Allan A. Ryan and Sherburne Prescott.

At the annual meeting of the stockholders, W. N. Thompson, of Indianapolis, and John J. Watson, Jr., of this city, were elected directors, R. E. Maypole and H. F. Campbell retiring from the board. Other directors were re-elected.

Net profits of the Stutz company for the first 6 months of this year, with the latter half of June estimated, approximates \$600,000, equal to \$8 a share on the 75,000 shares of stock outstanding. This total of approximately \$600,000 net profits in the first half of this year compares with \$649,042 net profits for the entire calendar year 1916.

NEW YORK, June 25—The retiring directors of the Fisher Body Corp. were re-elected at to-day's annual meeting, as follows: Charles T. Fisher, F. J. Fisher, Louis Mendelsohn, Albert Rothbart and Aaron Mendelson.

ST. JOHNS, MICH., June 25—Officers and directors of the new Triangle Motor Car Co., organization of which was recently announced in THE AUTOMOBILE, were elected last week as follows: Directors—Eugene Hart, Fred Von Thurn, Walter Burk, Raymond Hull, Fred Burk, Henry Kelly and Charles S. Clark. Officers—Eugene Hart, president; Fred Von Thurn, general manager; Walter Burk, secretary, and Raymond Hull, treasurer.

N. Y. May Exports Improved

Shipments from That Port Increased \$1,000,000—England Imports 1086 Trucks

NEW YORK, June 22—May automobile and truck exports were much improved, according to the returns of shipments from this port in that month, which amounted to \$6,228,024, compared with \$5,447,996 in April. As in the previous month, our motor vehicle exports were mainly to England and France, with several of the South American countries near the top of the list. During May England concentrated most of her buying in trucks, being our largest buyer, with a grand total of 1086 of these vehicles, valued at \$1,858,270, as compared with 418 in April, valued at \$1,290,594. The total truck exports from New York in May numbered 1440 and were valued at \$2,590,352. France bought 270 trucks, valued at \$577,012, compared with 175, valued at \$406,266 in April.

Passenger car exports were lower in May, due to the German submarine activities. As a result shipments of cars to Europe were small. The largest buyer of passenger cars was Argentina, numbering 404, valued at \$263,425. The total number of cars shipped from New York was 2990, valued at \$2,193,905, compared with 3413 in April, valued at \$2,541,844. Uruguay was our second largest passenger car buyer in May, with a total of 351, valued at \$196,656. Cuba bought 153 cars, valued at \$83,407.

France imported 255 cars in May, valued at \$113,925. England increased her April total from 11 to 112, valued at \$80,993, despite the scarcity of gasoline and restrictions put on the use of automobiles.

Parts exports were a little heavier in May, amounting to \$1,443,767, as compared with \$976,281 in April. England, France and Argentina were the largest buyers. English parts exports amounted to \$655,417, French to \$245,942 and Argentine to \$237,158.

Five Kissel Truck Models

HARTFORD, WIS., June 24—A longer wheelbase and loading space and the all year cab are the outstanding features of the new line of Kissel trucks announced by the Kissel Motor Car Co. These consist of the Flyer, with a chassis capacity, including body, of 2250 lb., costing \$1,085; the General Utility, capacity 3400 lb., at \$1,485; the Freighter, capacity of 5200 lb., at \$2,100; the Heavy Duty, capacity 8600 lb., at \$2,950, and the Dreadnaught, capacity 11,800 lb., at \$3,750.

The first model, formerly termed the $\frac{3}{4}$ -tonner, has been increased in wheelbase from 120 to 135 in. and with an 8-ft. loading space instead of 6 ft. 3 in. The next model has its wheelbase increased from 132 to 152 in. and a load-

ing space of 10 ft. instead of 8 ft. The third model has a 168-in. wheelbase instead of 144 in., and a 12-ft. loading space in place of 10 ft. The two largest models, the Heavy Duty and the Dreadnaught, have wheelbases of 168 and 180 in., respectively, and 13 and 14-ft. loading space.

The first two models have $3\frac{1}{2}$ by 5 $\frac{1}{2}$ -in. Kissel engines, giving 24.2 hp., S. A. E. The last three have $4\frac{1}{4}$ by 5 $\frac{1}{2}$ in. Kissel engines, giving 29 hp., S. A. E.

The Flyer has a special bevel gear drive, while the other four models are equipped with worm drive.

Sanford Truck Is Reorganized

SYRACUSE, June 23—The Sanford Motor Truck Co. has been reorganized and active control placed in the hands of E. A. Kingsbury, E. A. Dauer and J. E. Gramlich, all previously connected with the Chase Motor Truck Co. The company will market an entirely new line of trucks, including 1 and 2 ton internal-gear drive and 2 $\frac{1}{2}$ -, 3 $\frac{1}{2}$ - and 5-ton worm-drive models. The personnel of the new Sanford company follows: president, J. F. Durston; vice-president, C. Hamilton Sanford; secretary-treasurer, F. F. Sanford; general manager, E. A. Kingsbury; general sales manager, E. A. Dauer; chief engineer and designer, J. E. Gramlich; and assistant engineer, W. F. Hinnelsbach.

Reo Has Large Materials Stock

LANSING, MICH., June 25—The Reo Motor Car Co. has purchased enough materials to meet the company's needs up to January, 1918, and will this year turn out 100 per cent more trucks than in 1916 and 5000 more passenger cars than in the preceding 12 months. The company has orders on its books for more than 8000 passenger cars and a large number of trucks.

Connecticut Completes Lens Tests

HARTFORD, CONN., June 25—The State department of motor vehicles has completed tests upon lenses submitted by the manufacturers to date and has passed upon and issued a list of approved appliances. In issuing this list of devices and appliances the department has indicated in each instance the candle power of the light which was used in the test.

Recommend War Road Building

NEW YORK, June 25—A meeting held at the Automobile Club of America passed a resolution urging that the highway departments of the States co-operate with the War Department in the investigation of highways and the building of roads which will be of greatest value. The transportation of products makes certain highways important. It was also suggested that railroads should not be permitted to place an embargo on road building machinery and materials.

Trucks for U. S. Cost \$3,000 Each

87 Makers Bid for First 35,000 Army Transports for War Dept.

WASHINGTON, D. C., June 22—Averaging \$3,000 each, the motor truck makers in this country have given their bids to the War Department for the manufacture of 35,000 trucks to be used by the transport division of the United States Army. These will be used for an army of 2,000,000 men, and would represent an expenditure of \$105,000,000. Contracts were asked to hold good until the end of the present fiscal year.

Some eighty-seven makers are represented by the bids, which were mainly on 1 $\frac{1}{2}$ and 3-tonners. Time of delivery specified shows the makers are ready to begin turning trucks over to the Government at once in many instances, in 30, 60 or 90 days in others, and in 6 months in still others.

It is estimated that there are not more than 40,000 trucks on the entire western battlefield in Europe. An order of 35,000 trucks by the American Government will result in putting the United States on a par with all of the belligerents. A symposium of the bids opened by the quartermaster-general appears on page 1271.

Omaha Speedway to Be Dismantled

OMAHA, NEB., June 24—The Omaha speedway is to be dismantled after the races to be held here July 4. The track was built 3 years ago at a cost of about \$125,000.

Nineteen drivers have been entered for the race, which is an A. A. A. championship award event. Two races will be held, of 150 miles and of 50 miles.

Oldfield Defeats DePalma at Milwaukee

MILWAUKEE, June 24—Barney Oldfield to-day defeated DePalma in three special races of 15, 25 and 10 miles, respectively. Oldfield won the first race in 13:35 $\frac{1}{2}$, breaking the track record. He also took the next event of 25 miles in 23:42. The last event, 10 miles, was restarted on account of engine trouble experienced in Oldfield's car. On the second start, Oldfield took the lead and held it to the finish, his time being 9:02 4/5.

Burd Piston Ring Directory Out

ROCKFORD, ILL., June 25—The Burd High Compression Ring Co. has brought out its 1917 edition of its piston ring directory. This book contains the listing, both by sizes and by alphabetical order, of piston ring requirements for practically every automobile, truck and tractor manufactured in this country during the past 10 years, besides information of like character, covering the requirements of aeronautical, marine, stationary and other types of internal combustion engines.

A Synopsis of the Bids Opened by the Quartermaster-General

Bidder	Size in	Tons	Number	Price
				Each
J. C. Wilson Co.	1 1/2	4800		\$2915.00
United Motors Co.	1 1/2	1000		2300.00
United Motors Co.	3	1000		2870.00
Diamond T Motor Co.	1 1/2	700		2145.00
Diamond T Motor Co.	3	275		2965.00
O. Armleder Co.	1 1/2	100 up		2150.00
O. Armleder Co.	3	3 per day		2960.00
Maccar Truck Co.	3	120		3400.00
Maccar Truck Co.	1 1/2	60		2250.00
Bowling Green Motor Truck Co.	1 1/2	2000		2785.00
Bowling Green Motor Truck Co.	3	1000		3250.00
United 4-Wheel Drive Truck Corp.	3 1/2	1000		2515.00
Stegman Motor Car Co.	1 1/2	500		2515.00
Stegman Motor Car Co.	3	500		2945.00
Witt-Will Co.	1 1/2	12		2365.00
Dembly Motor Truck Co.	1 1/2	1050		2425.00
Sullivan Motor Truck Corp.	1 1/2	1400		3058.00
Indiana Truck Corp.	1 1/2	600		2562.00
Indiana Truck Corp.	3	600		3226.00
Willys-Overland Co.	1 1/2	10000		Cost plus 10%
International Motor Co.	3	850		4175.00
Sandow Motor Truck Co.	1 1/2	200		2115.60 net
Sandow Motor Truck Co.	3 1/2	100		2932.83
Kelly-Springfield Motor Truck Co.	1 1/2	10 per day		2600.00
Kelly-Springfield Motor Truck Co.	3	8 per day		3442.50
White Co.	1 1/2	3850		3150.00
White Co.	3	or 3400		3150.00
White Co.	3	1875		3800.00
White Co.	3	or 1675		3800.00
White Co.	1 1/2	2780		3150.00
White Co.	3	and 1070		3800.00
White Co.	1 1/2	2455		3150.00
White Co.	3	and 975		3800.00
White Co.		50 to 1425		3150.00
Nash Motors Co.		200		2465.00
Nash Motors Co.		1 to 35,000		2805.00
Hewitt-Ludlow Auto Co.	1 1/2	4 per mo.		2850.00
Hewitt-Ludlow Auto Co.	3	4 per mo.		3950.00
Tower Motor Truck Co.	1 1/2	500		1640.00
Tower Motor Truck Co.		300 to 600		Cost plus 10%
Blair Motor Truck Co.	3	10 per mo.		2750.00
Tractor Producing Corp.	3	3000 to 6000		4235.00
Wichita Falls Motor Co.	1 1/2	1 or more		2950.00
Wichita Falls Motor Co.	3	1 or more		3800.00
Republic Motor Truck Co.	1 1/2	3000		2025.00
Republic Motor Truck Co.		(Steel wheels \$75 extra)		
Republic Motor Truck Co.	3	300		2500.00
United States Motor Truck Co.	2 1/2	chain drive		2500.00
	3 1/2			3200.00
				2800.00
				3500.00
Informal bid				
Four-Wheel Drive Auto Co.	3	4000		3200.00
		200 per mo.		3200.00
G. A. Schaft Motor Truck Co.	1 1/2	100		2650.00
	3	100		3200.00
Garford Motor Truck Co.	1 1/2	1050		2730.00
	3	265		3200.00
Fageol Motor Truck Co.	2	100		3500.00
	3 1/2	50		4800.00
Dorris Motor Truck Co.	2	50		2160.00
	1 1/2	750		2687.00
Bessemer Motor Truck Co.	1 1/2	2325		2413.00
Acme Motor Truck Co.		2325		3313.00
	3	600		3000.00
H. E. Wilcox Motor Truck Co.	2	300		3000.00
Detroit Wyandotte Motor Truck Co.	3	1000		2200.00
Pull More Motor Truck Co.	3	775		2335.00
Reo Motor Co.	1 1/2	3 per day		1483.00
Oneida Motor Truck Co.	1 1/2	45		1855.00
	30			2520.00
Dayton Motor Truck Co.	3	150		4000.00
H. G. Burford Co.	1 1/2	2300		2463.00
	3	2300		3813.00
Clyde Cars Co.	1 1/2	1500		2465.40
	3	1500		3220.90
Beck Motor Truck Co.	2	150		1950.00
Moreland Motor Truck Co.	1 1/2	50		2250.00
	500			2881.50
	2000			2928.00
	3	25		2885.00
	650			2664.75
White Co.	1 1/2	50 to 1225		3800.00
	50 to 945			3150.00
Gramm-Bernstein Motor Truck Co.	3 1/2	20 to 480		3800.00
	759			2790.00
	695			3100.00
	330			3300.00
Gramm-Bernstein Motor Truck Co.	3 1/2	759		3420.00
	594			3750.00
	198			4000.00
Charles E. Riess & Co.	3	10 per mo.		3500.00
Attterbury Motor Car Co.	1 1/2	1 to 1000		3250.00
James Cunningham Son & Co.	3	300		3000.00
Standard Motor Truck Co.	2	5 per day		Cost plus 10%
	3 1/2	5 per day		Cost plus 10%
Transport Tractor Co.	3	100		4380.00
Noble Motor Truck Co.	1 1/2	25 to 50		2100.00
Globe Motor Truck Co.	1 1/2	75		1786.50
Hahn Motor Truck Co.	1 1/2	100		2100.00
Hannay Motor Sales Co.		6		1800.00
	4			1900.00
	6			2970.00
	4			3070.00
Day-Elder Motors Corp.	1			1031.25
	2 1/2			1887.50
Kissell Motor Car Co.	1 1/2	3 to 6 per day		2627.00
	6 to 10 per day			2100.00
Lippard-Stewart Motor Car Co.	1 1/2	35 per mo.		3237.00 chassis alone
				3487.00 body
				3312.00 chassis alone
Strict Government specifications				3562.00 body

Bidder	Size in	Tons	Number	Price
				Each
Packard Motor Car Co.	1 1/2	1 to 3000		3474.79 body
				3173.59 chassis
The above according to special army specifications if ordered before Aug. 10.	1 1/2	More than 3000		4170.59 body
				3808.31 chassis alone
The above if ordered after Aug. 10.	1 1/2	1 to 3000		3082.80 body
				2780.60 chassis alone
				More than 3000 3699.36 body
				3336.72 chassis alone
The above following government specifications in commercial trucks.	2	1 to 3000		2732.81 body
				2430.61 chassis alone
				More than 3000 3279.37 body
				2916.75 chassis alone
The above commercial trucks with special equipment.	3	1 to 3000		4125.23 with body
				3786.01 chassis
				More than 3000 4950.28 with body
				4545.21 chassis
The above special army trucks.	1 to 3000			3536.61 with body
				3197.39 chassis
				More than 3000 4243.93 with body
				5836.87 chassis
The above commercial trucks with special equipment.	1-3000			3143.03 with body
				2803.81 chassis
				More than 3000 3771.64 with body
				3364.57 chassis
The above without special equipment.	1 1/2	1 to 5000		2700.00 chassis alone
				2905.00 with body
	3			3150.00 chassis
				3405.00 with body
Brockway Motor Truck Co.	1 1/2	792		2975.00
Service Motor Truck Co.	50 to 150			2900.00
	50 to 200			2250.00
				2500.00
Federal Motor Truck Co.	2	1036		2332.00
	3 1/2	575		3011.00
Dart Motor Truck Co.	200 to 1000			3068.00
	1000 to 5000			2475.00
Moon Motor Car Co.	58 to 500			2550.00 chassis alone
				2835.00 with body
General Motors Truck Co.	3 models 1000			2390.00
				3140.00
Forschler Motor Truck Mfg. Co.	60			2025.00
Consolidated Motors Co.	533			2175.00
				2375.00 with body
Steward Motor Car Co.	600			1785.00
Selden Truck Sales Co.	2 ton 1500			2807.62
	1050			3716.02
Deneed Motor Truck Co.	250 to 500			3423.00 with body
	500 to 1000			3135.00 chassis
				3270.00 with body
Bourne Magnetic Truck Co.	2	4500		2750.00
Signal Motor Truck Co.	240			2300.00
	240			3000.00
Rowe Motor Manufacturing Co.	50 to 500			2595.60
Hurlburt Motor Truck Co.	1 to 35,000			2350.00 chassis
				3900.00
Bethlehem Motor Corp.	1 to 5000			2175.00
Corbitt Motor Truck Co.	133			2500.00
Locomobile Co. of America	Not less than 500			3972.44
	Not less than 250			4024.57
	Not less than 250			4078.82
	Not less than 1000			4171.68
	Not less than 500			4272.74
	Not less than 250			4324.87
	Not less than 250			4379.12
Other bids also submitted.				
Winther Motor Truck Co.				Commercial Army Model A
				More than 2000 2325.00
				1000 to 2000 2325.00
				250 to 500 2356.00
				250 to 500 2418.00
				100 to 250 2449.00
				1 to 100 2480.00
				More than 2000 3000.00
				1000 to 2000 3000.00
				500 to 1000 3040.00
				250 to 500 3120.00
				100 to 250 3160.00
				1 to 250 3200.00
				1000 to 3000 3100.00
				300 to 500 3100.00
B. & M. Truck Co.	3	100		3950.00
Staver Motor Car Co.				2173.50
Informal bids received after opening.				2273.50
Chicago Republic Truck Co.	2	6		2173.50
(Steel wheels)				2273.50
H. E. Wilcox Motor Company willing to take contract.				
Pierce-Arrow Motor Car Co.	2	100		3090.00
	800			3500.00 (special equipment)
	5	300		4300.00
Specials				1 to 35,000 4600.00
				1 to 35,000 3800.00
Bids received after opening.				
Rayford Truck & Tractor Co.				1700.00
H. J. Graham Engineering Corp.				1800.00
Washington Motor Truck Co.				2350.00
				3475.00
Royal Motor Truck Co.				3200.00
				3800.00

Ford Accessories Exhibited

National Exposition Planned
—Shows in Large Cities
—First in Chicago

CHICAGO, June 22—At a meeting held this week plans were laid for financing the national exposition of Ford accessories, a body of manufacturers that will direct shows throughout the country at which will be exhibited accessories made especially for Ford cars.

H. V. Buelow, Toledo, has been made show manager, and will have charge of all of the shows, the first of which will be held in Chicago in September, and others in the principal cities of the country on dates not yet determined.

Included in the personnel of officers and directors are men representing companies of national importance which mark the proposed show as one of more than local importance. It has been found that there are some 300 manufacturers who, it is hoped, will become members of the organization, the membership fee being \$100. This is not an annual fee but makes the membership permanent.

An office has been opened for Mr. Buelow in the New Southern, Chicago, from which details of the show will be worked out. It is proposed that a circular be published and that each member send out his pro rata of a total of 300,000 to Ford owners within a radius of 300 miles of Chicago. It is probable that this circular will carry the names of all members and the advertising of several.

NEW COMPANIES

GRAND RAPIDS, MICH., June 26—Promotion of a new company for the manufacture of demountable wheels is being completed in this city. The company is to be known as the Kol-ben Mfg. Co. and will be capitalized at \$200,000. Stock will be offered at \$10 a share. The company will manufacture hubs only for wire, wood or steel wheels.

INDIANAPOLIS, IND., June 23—The Britton Carburetor Co. has been incorporated with a capitalization of \$15,000. Carl G. Fisher, president of the Prest-O-Lite Co. and the Indianapolis Motor Speedway, is one of the incorporators. Associated with Mr. Fisher are Charles G. McCutchen and Quintin G. Noblitt.

INDIANAPOLIS, IND., June 23—The Long Light Lens Co., manufacturer of a new type of automobile headlight, of Kokomo, Ind., has been incorporated with a capitalization of \$25,000. Maurice Louth, Earl Barnes and Fred Trees are the incorporators. Each lens is composed of 800 smaller lenses, which diffuse light in such a manner as to prevent a glare.

COLUMBUS, OHIO, June 23—The Varni-Shine Co., which has been manufac-

ting an automobile body polish, is being reorganized, and headquarters will be located in Cleveland. James Price will be general manager, succeeding Mrs. C. C. Janes, who started the business and who retires because of ill health. The Columbus office will be retained.

COLUMBUS, OHIO, June 23—The Automatic Control Trailer Co., with offices in the Hartman Bldg., which was incorporated about 6 weeks ago for \$25,000, has turned out its first trailer. Officers of the company are: S. A. Kinner, president; Charles Seaman, vice-president; John T. Price, secretary-treasurer.

GRAND RAPIDS, MICH., June 23—The manufacture of a line of trucks of 1 and 2-ton capacity will be undertaken by the Muskegon Engine Co., Muskegon. This company makes a valveless four-cycle engine. C. E. Johnson, of Muskegon, is president, and H. L. Schuh, of this city, is vice-president.

NEW YORK, June 24—The Crescent Motor Truck Co. has been incorporated in this State to manufacture a 1500-lb. delivery car to be an assembled proposition and to sell around \$1,000.

The company has taken temporary quarters at 1457 Broadway. Production is expected to start by Sept. 1. The company is a closed corporation with a nominal capital of \$6,000. J. W. Brooks is president.

QUINCY, ILL., June 23—The Niswander Mfg. Co. has been incorporated to manufacture demountable automobile rim removers, rim tools and parts of automobiles.

DETROIT, June 23—The Picard Carburetor Corp., organization of which was mentioned in an earlier issue of THE AUTOMOBILE, has been incorporated in this state with a capital of \$100,000.

1075 Overlands in 1 Day

TOLEDO, June 26—The sales of the Willys-Overland Co. to-day were the largest in the history of the company for a single day, totaling 1075 cars. Shipments totaled 702 cars.

Stromberg Re-elects Officers

NEW YORK, June 27—The retiring directors of the Stromberg Carburetor Co. were to-day re-elected at the annual meeting.

Christmas Cove Junket, July 20

NEW YORK, June 25—The annual trip to Sam Miles' home at Christmas Cove, Me., will be held July 20. As in former years, the party will consist of prominent men in the automobile and accessory industry. It is expected that there will be about thirty-five in attendance. The party will meet at Portland July 20 and will proceed from there to Mr. Miles' estate, either by special boats or by automobiles.

National Credit Assn. Meets

Co-operation Keynote of Convention at Kansas City—Educational Work Planned

KANSAS CITY, Mo., June 24—Co-operation of all business interests to put American business on a sounder basis, for foreign as well as domestic trade, was the keynote of the annual convention in this city of the National Association of Credit Men June 19 to 22. One element of this co-operation was particularly important, because it is a comparatively new idea—the promotion of a better understanding between the credit men of manufacturers and wholesalers, and the retailers. This subject was discussed from the standpoint of the credit man by Fred T. Jones, of the H. W. Johns-Manville Co., who is president of the Cleveland Credit Men's Assn., under the title "Our Responsibility to Retail Merchants." He declared that the credit men should help the retailers to understand the principles of credit granting, for then the retailer would be able to appreciate the principles that will help him do larger and more profitable business.

To Increase M. & A. M. Grouping Committee

NEW YORK, June 25—It is expected that the present grouping of the M. & A. M. board, consisting of C. W. Stiger, W. O. Rutherford and L. M. Bradley, will be enlarged to about thirty-five members, composed of the board of directors and other members. A special meeting will be held in the near future to work out the plans of this committee. This meeting will be held in Cleveland or Detroit. As outlined in these columns, the grouping plan of the association is to separate those companies manufacturing like products into groups with their own chairmen and meeting places.

At last Friday's meeting of the association it was decided to change the date of the executive board meeting to the third Friday of each month instead of the second Friday and to change the monthly meeting of the credit committee to the third Thursday.

The association has voted in favor of the purchase of \$25,000 worth of Liberty Bonds and an additional amount for its employees.

Christian Girl, chairman of the show committee, and L. M. Bradley, manager, have concluded negotiations with the National Automobile Chamber of Commerce in regard to the 1918 show at the same terms and conditions as in former years.

Morris Bank Completes Organization

DETROIT, June 23—The Industrial Morris Plan Bank, of Detroit, has been organized to extend loans to automobile and other workers in this city. Edwin S. George, president of the Steel King Mo-

tor Plow Co., is president and Eugene W. Lewis, vice-president of the Detroit Axle Co., is vice-president. Automobile makers were instrumental in organizing this bank, the purpose of which is to eliminate the evils of the loan charge as regards motor car workers.

Senate Levies 5% Tax on Advertising

WASHINGTON, D. C., June 27—The Senate finance committee, considering the revenue bill, has adopted a provision fixing a tax on one-fourth of one cent per pound on second class postage and a tax on advertising of 5 per cent, with an exemption up to \$4,000.

No Change in Studebaker Cars

DETROIT, June 27—The Studebaker Corp. has issued a statement to the effect that there will be no change in their models this year.

LATE NEWS BY WIRE

FLINT, MICH., June 26—The Champion Ignition Co. has received orders for sample spark plugs from the Government. The plugs are to be given severe tests for aviation, passenger car and truck service.

DETROIT, June 26—The Parker Rust Proof Co. of America received orders last week from the United States Government to install a complete Parker rust proofing plant in the Government arsenal at Rock Island City, Ill.

Import Duty on Gasoline Lifted

MEXICO CITY, June 27—Import duties on gasoline and higher petroleum derivatives have been lifted. This places Mexican refiners in competition with those of the United States and has caused a sudden rise in price of gasoline to 50 cents a gallon.

G. M. Ambulances for U. S. Army

PONTIAC, MICH., June 27—The General Motors Truck Co. has received an order for 1000 1½-ton chassis to be used for ambulances in the Medical Corps, United States Army.

Regal Par Reduced to \$10

DETROIT, June 27—The par value of the Regal Motor stock has been reduced from \$100 to \$10 per share.

Pierce Stock Listed on Exchange

NEW YORK, June 27—The governors of the Stock Exchange have admitted the Pierce-Arrow securities to the official list. In all \$6,207,400 preferred and 166,268 shares of the company's stock have been listed.

J. B. Pierce, Atterbury Pres., Dead

BUFFALO, June 22—J. B. Pierce, president of the Atterbury Motor Truck Co., died to-day at his summer home in Lynnfield, Mass.

Truck Convention July 9

Meeting To Decide Details of Military Truck Open to All S. A. E.

WASHINGTON, June 27—At the meeting of truck engineers and parts makers held at the Bureau of Standards to-day, it was agreed to call a larger meeting in Columbus, Ohio, on July 9 at the University of Ohio. Previous to this meeting the sectional and divisional committees will meet and complete the suggested standard designs for the different parts. The general meeting will consider these in detail and also the whole assembly.

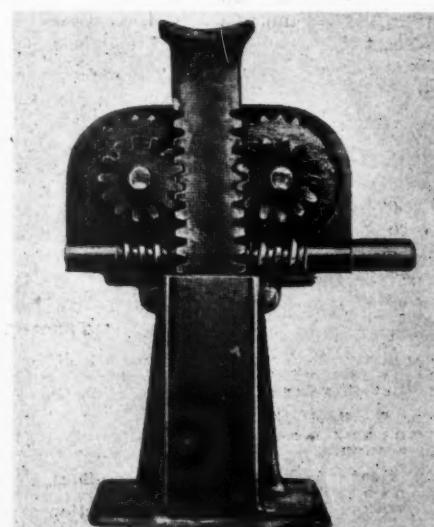
Captain Britton of the War Department will attend and it is expected that complete finality will be reached. The meeting is open to all members of the S. A. E. and a very large attendance is desired.

House Passes River Rouge Bill

DETROIT, June 26—The House of Representatives last night passed a \$490,000 appropriation required to even the River Rouge sufficiently to permit the docking of deep draft ships at the proposed new Ford smelter and tractor plant.

Rees Is New Type Jack

PITTSBURGH, June 23—A new line of lifting jacks has been placed on the market by the Service Corp., this city. This company has been manufacturing jacks for industrial purposes for several years and now has turned its attention to the automobile field, for which it has developed two models, one suitable for passenger cars and motor trucks up to 2 tons capacity and the other for trucks of 5 tons capacity. The mechanism of the jack consists of a double worm, right and left hand, meshing with two worm wheels. Each of these worm wheels is



New Rees jack, showing operation

formed integral with a spur pinion at its side and these two pinions mesh with racks cut on the ram or hoist of the jack. The worm is made of crucible steel and wheels are of malleable iron. The mechanism is self-locking and the ram can be raised and lowered only by turning the worm. To raise it the worm must be turned clockwise and to lower it anti-clockwise. The gear reduction is such that four and one-half turns of the worm raises the ram 1 in. The No. 1 jack weighs 12 lb. and the No. 2, 14 lb. The former has a maximum lift of 6½ in.

Folding Handle

An interesting feature of the jack is the collapsible folding handle by means of which it is operated, which obviates the necessity of the operator crawling underneath the car in order to place the jack in position under the rear axle, and to operate it. This collapsible handle is made in three sections; when extended it is about 3 ft. long and when folded, about 18 in. It is provided with a socket fitting over the end of the worm shaft and a locking ring is provided which when turned through a small angle locks the handle on the shaft and prevents it from coming off. The jack can then be swung and shifted into position under the axle by means of the handle. A universal joint in the handle near the socket permits of operating it from difficult angles. This collapsible handle is preferred for touring car use. For truck purposes the company has developed a ratchet-operating device on which a patent has been applied for.

U. S. Permanent Aircraft Exhibit

WASHINGTON, June 27—The National Advisory Committee for Aeronautics and the Aircraft Production Board have instituted a project for a permanent exhibit of aircraft materials of all kinds, including engine parts and sections of planes, to be established in Washington for the benefit of army and navy engineers and manufacturers. A building to house the exhibit is now being constructed by the Government south of the Smithsonian institute and the display will be made available to all aircraft manufacturers and kept up-to-date as the science develops.

The latest foreign machines and specialized parts from foreign makers reflecting the highest development of European building science in the 3 years of war, will be displayed.

Airplane Mission Safe in Europe

WASHINGTON, June 27—Safe arrival is reported at a British port of 125 experts, sent from this country to acquire and bring back to the United States all possible information regarding aircraft designing and manufacture of both engines and planes. Included in the delegation are men representing legal, manufacturing, designing, engineering, military and naval experience and training, it is stated by the Aircraft Production Board.

Automobile Calendar

ASSOCIATIONS

July 10-11—Chicago, National Automobile Dealers' Assn., Organization Meeting, Hotel La Salle.

Sept. 12-14—Atlantic City, N. J., Motor and Accessory Manufacturers, Mid-Season Meeting.

Sept. 25-28—Pittsburgh, National Assn. of Purchasing Agents, Convention.

CONTESTS

1917

July 4—Omaha, Neb., Speedway Race, Championship.

July 4—Uniontown, Pa., Speedway Race.

July 4—Tacoma, Wash., Speedway Race.

July 4—Visalia, Cal., Road Race.

July 4—Spokane, Wash., Track Race.

July 4—Benton Harbor, Mich., Track Race.

July 14—Rochester, N. Y., Hill-climb.

July 15—Missoula, Mont., Track Race.

July 17-19—Buffalo, N. Y., Inter-city Reliability.

July 22—Anaconda, Mont., Track Race.

July 29—Great Falls, Mont., Track Race.

Aug. 5—Billings, Mont., Track Race.

Aug. 17—Flemington, N. J., Track Race.

Sept. 3—Uniontown, Pa., Speedway Race.

Sept. 3—Cincinnati, O., Speedway Race, Championship.

Sept. 6—Red Bank, N. J., Track Race.

Sept. 8—Hillclimb, Pike's Peak, for stripped stock chassis.

Sept. 15—Providence, R. I., Speedway Race, Championship.

Sept. 22—Allentown, Pa., Track Race.

Sept. 28—Trenton, N. J., Track Race.

Sept. 29—New York Speedway Race, Championship.

Oct. 6—Danbury, Conn., Track Race.

Oct. 6—Uniontown, Pa., Speedway Race.

Oct. 13—Richmond, Va., Track Race.

Oct. 13—Chicago Speedway Race, Championship.

Oct. 27—New York Speedway Race.

SHOWS

Aug. 6-10—Fremont, Neb., General Tractor Demonstration.

Sept. 2-9—Spokane, Wash., Interstate Fair.

Sept. 9-15—Milwaukee Show, State Park Fair, West Allis.

Sept. 9-15—Milwaukee, Wis., Fall Show, Wisconsin State Fair, West Allis, Milwaukee Automobile Dealers.

Oct. 13-28—Dallas, Tex., Dallas Automobile & Accessory Dealers Assn. State Fair.

Engineering Calendar

American Railway Master Mechanics' Assn.
American Institute of Electrical Engineers.

Master Builders' Assn.

American Society of Heating and Ventilating Engineers.
Association Iron and Steel Electrical Engineers.

Mining and Metallurgical Society of America.

Society of Automotive Engineers.

JUNE

26-30—Amer. Soc. for Test. Mat. annual meeting Atlantic City, Hotel Traymore, Business meetings, reception and golf tournament.

JULY

7—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

12—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

14—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

16—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

21—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

AUGUST

4—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

11—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

14—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

20—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

21—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

SEPTEMBER

1—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

10-14—Assn. Iron & Steel Elec. Engrs. annual convention at Phila.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

11—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

17-18-19—Amer. Gas. Inst. at Washington, D. C.

18—Mining & Met. Soc. Amer. monthly meeting New York section Engrs. Club.

20—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

Illuminating Engineering Society.

National Electric Light Assn.

National Gas Engine Assn.

American Society for Testing Materials.

American Institute of Metals.

American Foundrymen's Assn.

Society Naval Architects and Marine Engineers.

24—Amer. Inst. Metals at Boston.

24—Amer. Fdry. Assn. annual meeting at Boston.

OCTOBER

6—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

11—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

13—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

15—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

17-18-19—Amer. Gas. Inst. at Washington, D. C.

18—Mining & Met. Soc. Amer. monthly meeting New York section Engrs. Club.

20—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

NOVEMBER

3—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

10—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

12—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

12—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

15—Mining & Met. Soc. Amer. monthly meeting New York section at Engrs. Club.

15-16—Soc. Naval Arch. & Marine Engrs. annual meeting.

17—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

19—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

DECEMBER

1—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

11—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

14—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

15—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

17—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

20—Mining & Met. Soc. Amer. monthly meeting New York section at Engrs. Club.



KING EIGHT RELIABILITY

WILLIAM G. McADOO, *Secretary of the Treasury*, in giving the signal that started the King on its seven-day non-motor-stop run in St. Paul, honored with his presence the placing of one more block on the carefully reared structure of King RELIABILITY.

The stock car which began that seven-day test had already traveled 29,550 miles, and is the same car used in the famous 10,850 mile non-motor-stop run at Sheepshead Bay under Official A. A. A. supervision.

King RELIABILITY was most adequately proved when the United States Government, after the most severe official tests, adopted the King chassis for armored cars.

It has been proved by high-gear climbing achievements on Mt. Wilson, the San Bernardino Mountains, Mt. Hilo, Mt. Diablo, and Lookout Mountain—all made with stock cars.

It has been proved by the "sealed-in-high-gear" non-stop and fuel-economy tests made in California, Colorado, Virginia, New York and seven other states—every test either officially conducted or made under impartial supervision.

It is being proved daily by the satisfactory operation of King cars all over America and in fifty-two foreign countries—in every climate and on all kinds of roads.

The King deserves your consideration if you intend spending \$1000 or more for a car. Its performance, appearance and comfort may persuade you to pay its price—or make you doubt the necessity of paying more than its price.

4-Passenger Foursome \$1700
7-Passenger Touring Car 1650

7-Passenger Sedan \$2300
3-Passenger Roadster 1585

Prices F. O. B. Detroit and subject to increase at any time. Wire Wheels \$100 extra

Send for catalog in full color and name of near-by King dealer

KING MOTOR CAR COMPANY, DETROIT



"The Car of No Regrets"



Saving Money on Motor Oil

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at the lowest price *per gallon***

On the contrary, the higher-priced, well known brands of oils are generally more dependable and afford better and more economical lubrication of the motor under varying conditions of speed, load and temperature.

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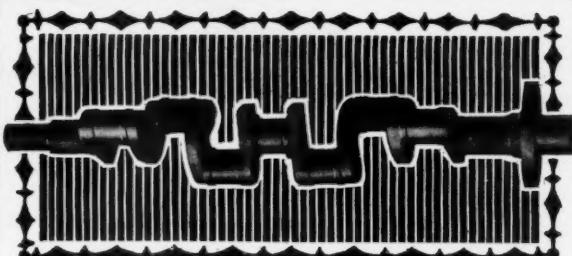
THE CLASS JOURNAL COMPANY
231-241 W. 39th STREET NEW YORK CITY

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IT IS WORTH A GREAT DEAL to the motor car manufacturer—in time and money saved, as well as insurance of the reputation of his car.

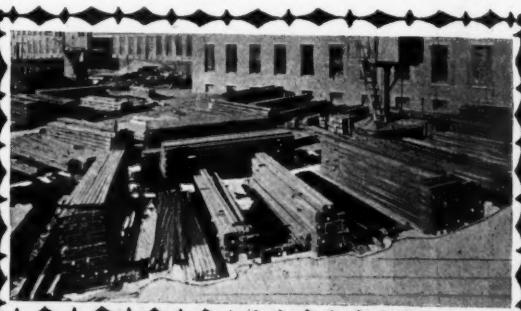
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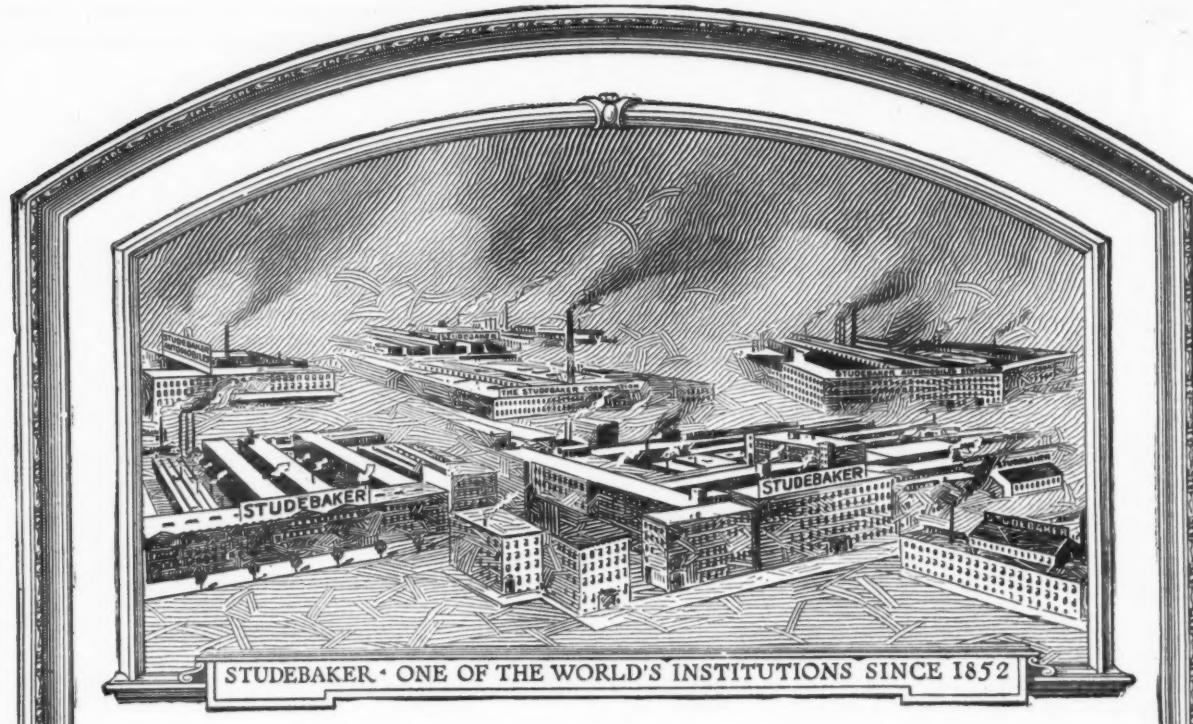
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You Ride on the Springs



EVERY car is equipped with springs in order to make it ride easily, but if these springs are not kept lubricated so you get spring action they are absolutely useless—you might as well have a solid piece of steel.

Heretofore the lubricating of springs has been a tedious, irksome task—but it need be no longer if you will use

JOHNSON'S STOP-SQUEAK OIL

It is very easy to apply—you don't need a tool of any kind—it isn't even necessary to jack up the car—simply paint it on with a brush or squirt it on with an oil can.

It Penetrates

Johnson's Stop-Squeak Oil has the remarkable property of seeping rapidly between the spring leaves and to the furthermost wearing points and it there becomes a heavy bodied lubricant, allowing perfect spring action.

For Squeaks of All Kinds

Johnson's Stop-Squeak Oil removes squeaks of all kinds—in springs—shackle bolts—body—fenders—top, etc. It also reduces the liability of spring breakage.

It is a simple remedy for hard riding cars. Applied to the side of springs—it will quickly penetrate between the leaves driving out the rust and lubricating them thoroughly.

Make Your Car Ride Easily

Instead of bumping over the road you can fairly float along if your springs are lubricated so you have spring action. If spring leaves are rusted together you might as well be riding on a solid piece of steel.

Insist upon your dealer supplying you with Johnson's Stop-Squeak Oil. If he cannot do so use attached coupon.

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& SON

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Enclosed please
find \$1.00 for which
please send me by pre-
paid express, one quart
of Johnson's Stop-Squeak
Oil—enough for a season's
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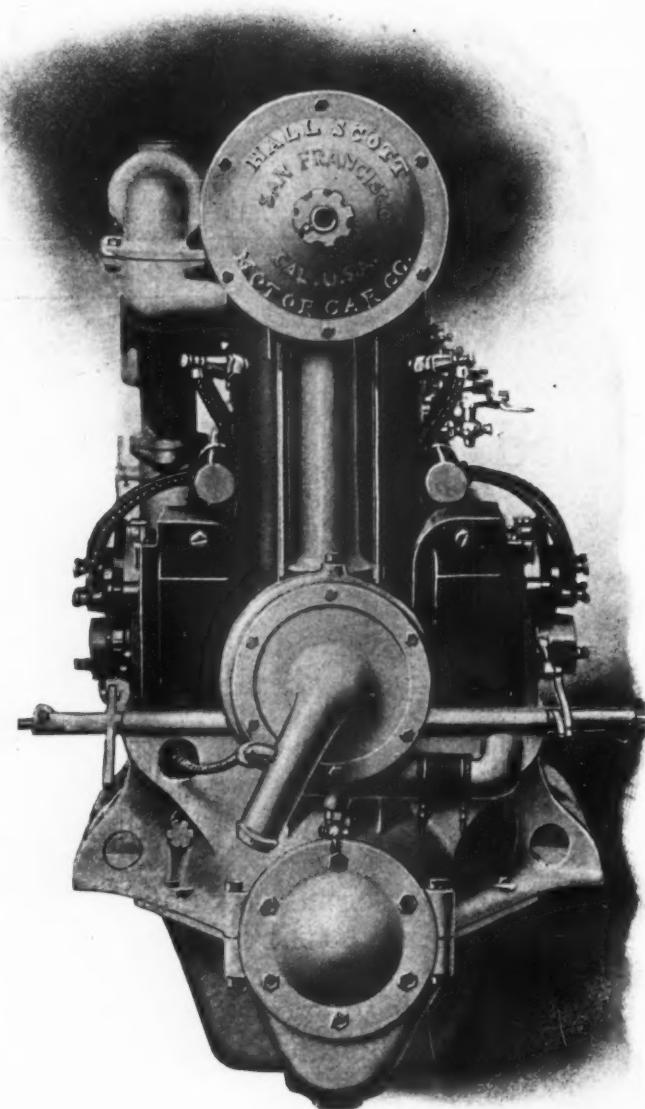
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My Dealer is

Non-Gran in the Hall-Scott Motor



It is but natural that Non-Gran Bushings are found in Hall-Scott Motors.

Look over the specifications of any of the fine motors built in America and you will find Non-Gran Bushings at those important points where wear would be fatal and where resistance to wear is therefore all important.

It makes no difference where these motors are built—New York, New Jersey, Ohio, Indiana, Michigan, Illinois, Wisconsin or California—their wear-subjected, non-adjustable bushings come from Berwyn, because in Non-Gran Bronze is found correct and adequate quality and the certainty of *maintained* uniformity.

American Bronze Company Berwyn Pennsylvania

HIGH SPEED NON-GRA BEARING BRONZE

Please mention The Automobile when writing to Advertisers

GRAND RAPIDS, MICH.

**THE STRATEGICAL CENTER
OF THE AUTOMOBILE
BUSINESS OF AMERICA**



Here follow some facts which it may do the automobile industry of America as much good to learn as it will do Grand Rapids to state them:

Please mention The Automobile when writing to Advertisers

51% of the Motor Cars and Trucks in the United States Are in Service Within 500 Miles of Grand Rapids

AT the doorstep of Grand Rapids is a vast, growing consumer market which annually absorbs great volumes of automobile products. In the state of Michigan alone there are over 160,000 automobiles—or about one car for every fifteen in population. This alone proves the great wealth and the enormous buying power of this zone.

Conservatively estimated, the Grand Rapids zone buys annually about \$75,000,000.00 worth of tires, \$5,000,000.00 worth of spark plugs, and easily \$15,000,000.00 worth of other accessories, not to mention the small ocean of oil and gasoline required to keep these cars going.

Here is a big market for your products, within a night's travel in any direction of Grand Rapids.

You cannot help but recognize the great advantages offered you when you locate your factory at Grand Rapids, the strategical center of the automobile industry of the United States.

We will gladly give you specific information, telling you exactly what Grand Rapids offers you, your factory and your products. Write us your requirements. Ask us for facts and figures. Just start something. Write—

GREATER GRAND RAPIDS ASSOCIATION
407-408 GRAND RAPIDS SAVINGS BLDG., GRAND RAPIDS, MICH.



54% of the Dealers, Garages, Repair Shops and Supply Houses in the United States Are Located Within 500 Miles of Grand Rapids

WITHIN easy reach of Grand Rapids is a great army of automobile accessory jobbers and dealers. This offers you a big outlet for your manufactured product at a minimum selling expense. It offers you an opportunity to concentrate your selling efforts in territory within easy reach of your factory, and at the same time in the most productive territory to be found anywhere in the United States.

Reaching out for distant territory can be a secondary consideration. Right here, within 500 miles of Grand Rapids are sufficient buyers and sellers of pleasure cars, motor trucks, accessories and supplies to keep your factory busy day and night. To make the maximum success, your business demands that the factory be located in the territory from which you naturally expect most of your business. Grand Rapids is the center of the greatest purchasing territory in the country. There can be no doubt about that.

Grand Rapids offers you opportunities that are second to none. The map on the opposite page and the figures at the top of this page prove it. Make Grand Rapids *your* factory location. It is the strategical center of the automobile industry. Tell us your requirements. We will tell you what Grand Rapids has to offer you.

GREATER GRAND RAPIDS ASSOCIATION

407-408 GRAND RAPIDS SAVINGS BUILDING, GRAND RAPIDS, MICH.

Please mention The Automobile when writing to Advertisers



72% of the Manufacturers of Pleasure Cars and Motor Trucks in the United States Are Located Within 500 Miles of Grand Rapids

GRAND RAPIDS is the geographical center of the motor car industry. The great bulk of the motor cars of the United States are manufactured in the Grand Rapids 500-mile zone.

The great percentage of parts, accessories and specialties used as standard equipment is taken by this territory.

Grand Rapids is the logical location for your factory. It offers you any number of inducements. The wage and labor situation, the raw material markets, the jobber, dealer and consumer markets, they all shout Grand Rapids as the logical manufacturing point for any product used by or in connection with the big automobile industry.

You cannot find a better manufacturing location than Grand Rapids. The more you investigate, the more certain are we that you will select Grand Rapids for *your* factory location. Here you will be within easy reach of all the big markets, the manufacturers, the jobbers, the dealers and the consumers. They are all at the front door of Grand Rapids.

Just think it over, then write us for specific information.

GREATER GRAND RAPIDS ASSOCIATION
407-408 GRAND RAPIDS SAVINGS BLDG., GRAND RAPIDS, MICH.



A Page of Facts About Grand Rapids

The population of Grand Rapids is 137,000 (1917 estimate).

The area of Grand Rapids is 17.5 square miles.

Grand Rapids has seventy (70) miles of street railway.

Grand Rapids has 217.5 miles of improved streets.

Grand Rapids has 229.5 miles of water mains.

The daily capacity of the Water Works in Grand Rapids is thirty-five million (35,000,000) gallons.

The daily average amount of water pumped in Grand Rapids in 1915-16 was 10,352,093 gallons.

Grand Rapids has the lowest average death rate of any large city east of the Mississippi river.

Grand Rapids has the sixth lowest average death rate of any large city in the United States.

Grand Rapids has thirty-four (34) public schools.

Grand Rapids has four (4) public high schools.

Grand Rapids has more open air schools in proportion to its population than any other city in the United States.

Grand Rapids maintains a Junior College Course where two years' University credits are obtainable.

The assessed valuation in Grand Rapids in 1916 was \$163,726,341.

Grand Rapids has the lowest tax rate of any city in Michigan with fifteen thousand (15,000) population or over.

The public library of Grand Rapids has 157,172 volumes.

Grand Rapids ranks second in the United States as to the per cent of home ownership.

The building and loan associations of Grand Rapids have 8,804 members.

Grand Rapids has eleven (11) banks and two (2) trust companies.

Grand Rapids has as modern a filtration plant as there is in the United States.

The bank clearings in Grand Rapids in 1916 were \$222,000,000.

The postoffice receipts in Grand Rapids in 1916 were \$721,232.97.

Grand Rapids issues annually building permits to the valuation of about four million dollars (\$4,000,000).

Grand Rapids leads all the cities of the United States in infant welfare work.

Grand Rapids does a wholesale business of approximately forty million dollars (\$40,000,000) annually.

The manufactured products of Grand Rapids are valued at fifty million dollars (\$50,000,000) annually.

The four leading industries in Grand Rapids are furniture, flour, machinery and printing.

Grand Rapids has the two largest show case factories in the world.

Grand Rapids has the largest sticky fly-paper factory in the world.

Grand Rapids has the largest carpet sweeper factory in the world.

Grand Rapids has the largest factory in the world making refrigerators.

Grand Rapids has the largest factory in the United States making manual training equipment for public schools.

Grand Rapids has the largest factory in the United States making school seats, church pews and opera chairs.

Grand Rapids is the largest producer in the world of gypsum products.

Grand Rapids has the largest factory in the world making window sash pulleys.

Grand Rapids has the largest factory in the world making asphalt shingles.

Grand Rapids has the only factory in the world making a metal belt lacer and a machine to lace belts with.

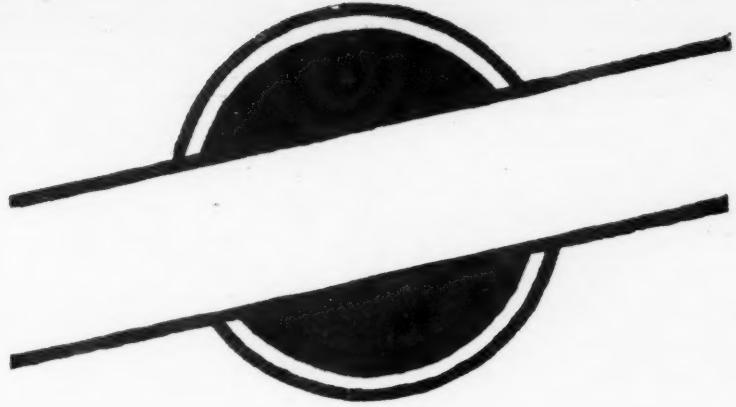
Grand Rapids has the only factory in the world making machines to fasten buttons on shoes.

Get acquainted with Grand Rapids, the Strategical Center of the Automobile Industry of America

GREATER GRAND RAPIDS ASSOCIATION

407-408 GRAND RAPIDS SAVINGS BLDG., GRAND RAPIDS, MICH.

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Next Week

in this publication, one of the best known and most successful manufacturers of passenger cars and one-ton trucks selling under \$800, will make an announcement of PROFIT-MAKING significance to every dealer and distributor in this business who is looking for a broader, more productive field in which to capitalize *fully* his merchandising ability.

Watch for this announcement.

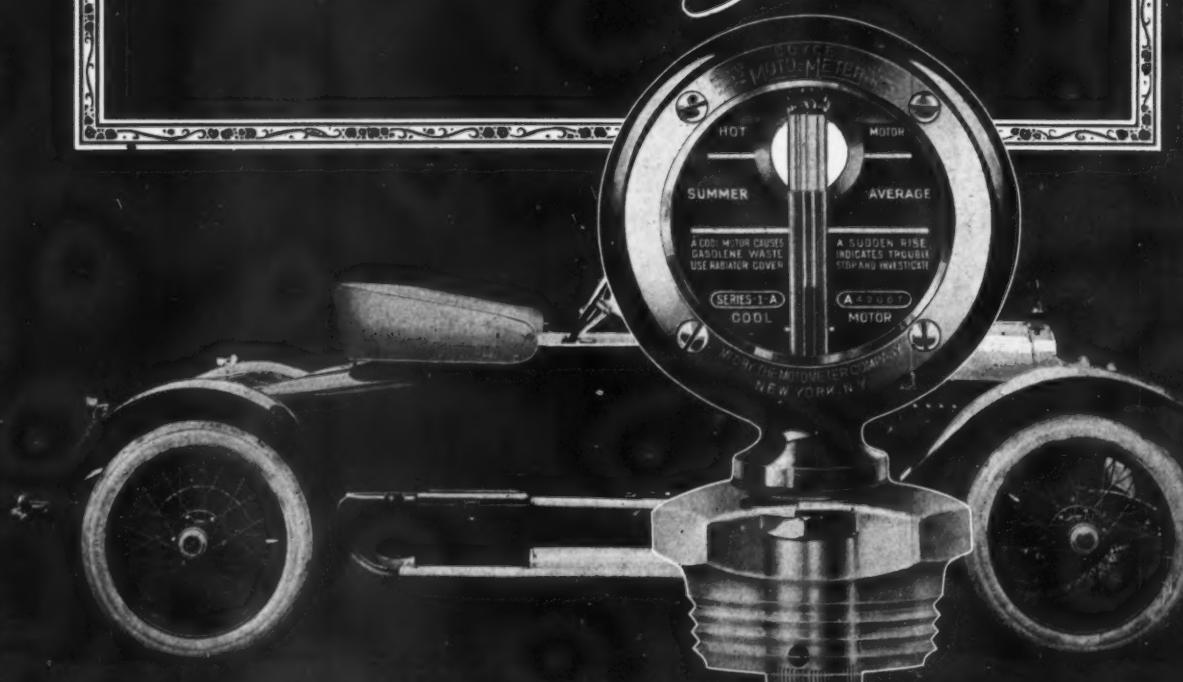
For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.



BOYCE MOTO-METER

The writer considers your MOTO-METER not as an accessory but as a necessity and one which tends to enlighten the driver more than any other device which has been placed on the market for some time.

H. D. Stutz



THE MOTO-METER COMPANY, Inc. LONG ISLAND CITY NEW YORK

WHITE
GLENN MARTIN AERO
FILW. MFG. CO.
DREXEL
ROAMER
MURRAY
MONROE
HUDSON
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BOUR-DAVIS
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BEN-HUR
AMERICAN
CASE
HASLER
WILLYS-KNIGHT
JORDAN
PENNSY
SEAGRAVE
SINGER
STATES
LOZIER
ANDERSON
CUNNINGHAM
DETROITER
HAL TWELVE
MCFARLAN
LEXINGTON
DENMO TRUCK
NETCO TRUCK
MARTIN
VELIE
STEARNS-KNIGHT
PATHFINDER
PEERLESS
JEFFERY
PEUGEOT
OWEN-MAGNETIC

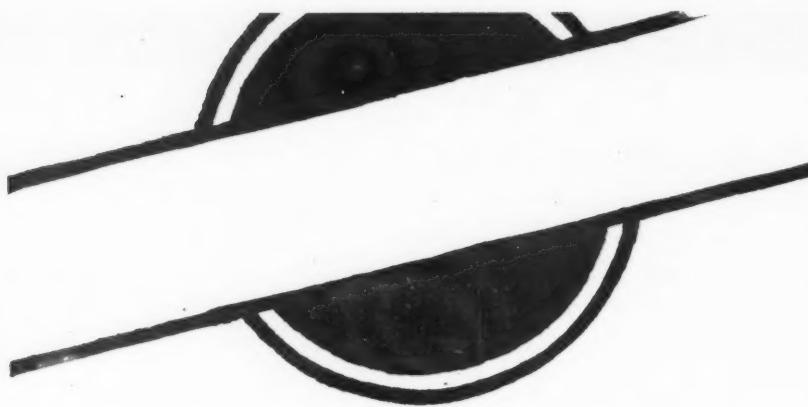
WESTCOTT
CRANE-SIMPLEX
PREMIER
JEFFERY QUAD
AHRENS FOX
SAYERS & COVILL
PACKARD TRUCK
SIMPLEX
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MERCER

1915 1916 1917

**BOYCE
MOTO-METER**
That day has arrived.

The Moto-Meter Co., Inc.
15 Wilbur Ave., Long Island City, N. Y.



This company's
distributors' proposition is attractive enough to interest the largest and most important distributors in the country. Demonstrated merchandising ability and solid financial backing are two requirements.

See announcement next week

For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.



SEXTON'S Castor Motor Oil WINS!

100-Mile Non-Professional Chicago Speedway Race Remarkable Victory for Oil and Car

Percy Ford, Jr., driving a HAYNES Light 12 broke the world's amateur record for 100 miles at Speedway Park, Chicago, Saturday, June 16, winning the amateur classic of America with an average of 89 miles per hour—without a stop—duplicating the non-stop record of William Leet, who won this event last year in a Mercer—both using Sexton's Castor Motor Oil.

The Only Car with a Non-Stop Record

Ford's HAYNES Light 12 was the only one in this race that was not forced to stop at the pit for engine repairs. He used SEXTON'S Castor Motor Oil! This feat demonstrates clearly under the most severe test possible that a lubricant can be subjected to, that SEXTON'S Castor Motor Oil is the most perfect lubricant for the modern motor.

SEXTON'S Castor Motor Oil is not a special racing oil, it is designed especially for the ordinary pleasure car.

A patented compound of pure castor oil with other vegetable and mineral oils in scientifically determined proportions. It is the only Perfect heat resisting oil. It prevents the motor overheating, reduces friction to the minimum and has greater viscosity than any other lubricant for internal combustion engines. Guaranteed to give two to three times more mileage than any other oil on the market. No odor. Less carbon. These are not mere claims but facts, proven by actual test in thousands of motor cars in every-day use throughout the world.

You Need SEXTON'S for Your Car—Buy It Now

In the following grades: Light, Medium, Heavy, Extra Heavy, Knight Special, Ford Special, Chalmers Special, Motorcycle Special and High Speed Special, the latter for those desiring excessive speed. Get it today from your dealer, or use the coupon.

SEXTON OIL COMPANY

1173 Peoples Gas Bldg. CHICAGO, ILL.



SEXTON
OIL CO.

1173 Peoples Gas Bldg.
Chicago, U. S. A.

Please send me full details regarding Sexton's Castor Motor Oil.

My car is.....

Name

Address

Please indicate by X mark whether
() car owner () dealer () distributor

Why United Tractors Will Revolutionize Your Hauling



You can pull a much heavier load—



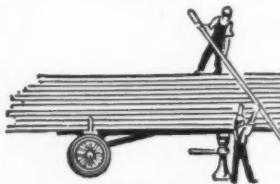
than you can carry. The United Tractor pulls the load; the motor truck carries it.



One trailer is being loaded, while—



the United is on its way with another load and—



a third trailer is being unloaded at other end of haul. No idle power. No idle men.

Because—

the United has every qualification of the motor truck—it can do many things a truck cannot do—operate one or several semi-trailers (doing the work of as many big trucks)—is of six-ton capacity, but sells at half the price of a five-ton truck.

Six-Ton Capacity \$2490

Whether you need one truck or three, we can prove to you that the United Trailer Tractor will not only save you a great deal of money in "first cost" and operating expense, but that it will do *better* work for you and more of it.

Where there is work for but one truck, the United cuts initial cost in half, hauls cheaper and does better work.

Where there is work for more than one truck, the United offers a tremendous saving of investment, depreciation, operating cost, and has many exclusive advantages.

With one tractor at a cost of but \$2490, two or three trailers can be operated, thereby giving the service of as many trucks, and an outlay for but *one* power unit. Additional trucks cost thousands, additional trailers only a few hundred.

The United offers many other advantages over motor trucks, a few of which are as follows: Operates semi-trailers with any

type of body equipment such as stake, gravity dump, hydraulic dump, etc. (we furnish all types of body equipment)—it turns in a much smaller circle—does not block narrow streets or alleys—absolutely no payload weight on chassis—no load strains on clutch or motor-backs as readily as a truck and is operated in tight places to much better advantage—uses wagon equipment—weight distributed over three axles—hauls three-ton loads more advantageously than a truck of three-ton rating.

Consider carefully the remarkable economy and many advantages of the United Tractor. Can you afford to operate truck equipment in the face of these established facts? It will be to your decided advantage to talk over your hauling problems with your United dealer.

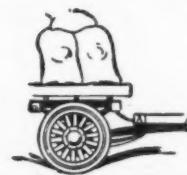
We will be glad to send illustrated tractor catalog on request. Dealers are invited to write for our liberal proposition. Or come to the factory. Address

UNITED MOTORS COMPANY
697 North Street

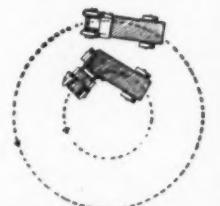
Manufacturers of
United Motor Trucks
and Tractors



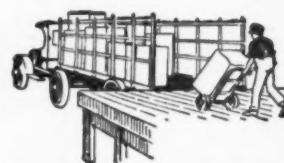
Sixty per cent of load weight is carried on rear axle of trailer.



Patented Spring Suspension gives utmost flexibility and frees chassis and power plant from load strains.



Much shorter turning radius. Does not block streets or alleys.

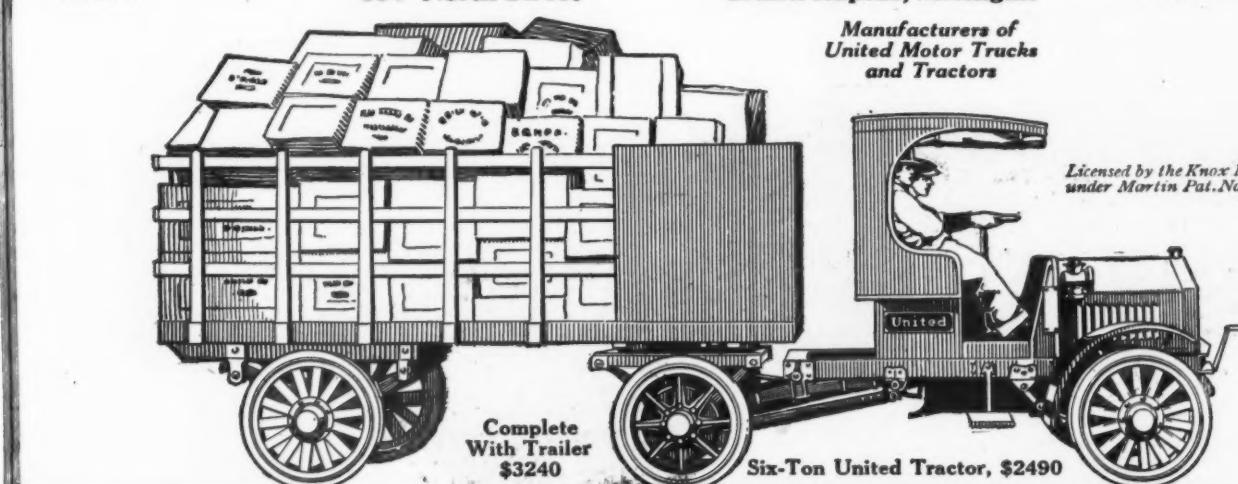


Tractor with trailer backs as easily as a truck.



Operates equally well with stake, solid body or dump body trailers.

Licensed by the Knox Motor Co., under Martin Pat. No. 1,018,248.



Please mention **The Automobile** when writing to Advertisers

Convincing Evidence -





F. H. Berger says:

WE take pleasure in commenting on your A. C. Spark Plug to the effect that they have given us excellent results in every way, and we therefore use them as standard equipment in our cars.

The writer personally, for the past seven years, has made many experiments with A. C. plugs and has found them always the most up-to-date and efficient product. There is no question in the writer's mind that, if there can still be made a more efficient plug than the present A. C., it will be made by the Champion Ignition Co. of Flint.

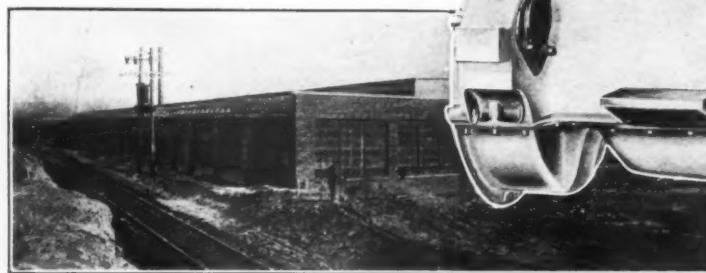
ABBOTT CORPORATION

A handwritten signature in cursive script that reads "F. H. Berger".

Chief Engineer

ABBOTT

THE ABBOTT CORPORATION CLEVELAND



H. G. Hobbs says:

We have found your plugs to be as follows:

THE porcelains are large and of extremely high dielectric strength, not dropping off rapidly at higher temperatures.

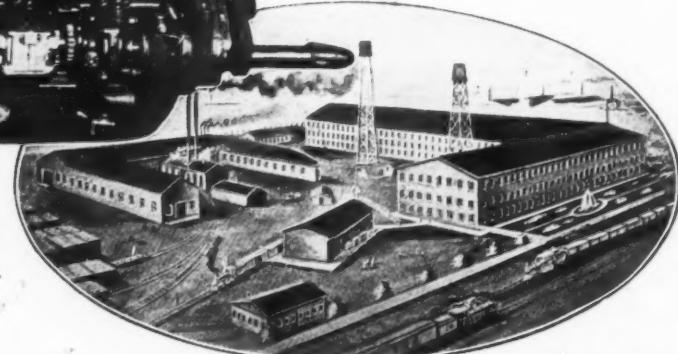
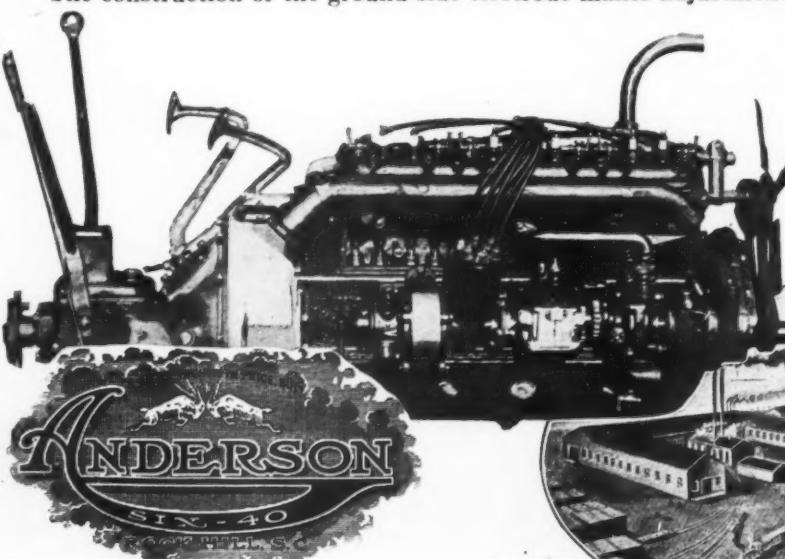
The alloy of the electrodes is of very high fusing point, therefore causing no pre-ignition of gases. The construction of the ground side electrode makes adjustment easy.

By these facts and tests we will continue to use your products.

ANDERSON MOTOR CO.

A handwritten signature in cursive script that reads "H. G. Hobbs".

Engineer



AC
TITAN

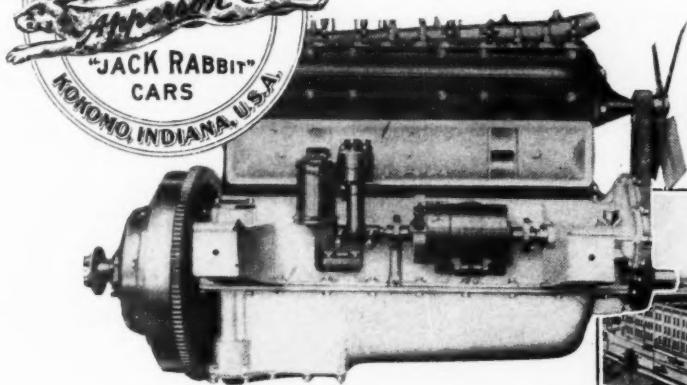


Edgar Apperson says:

JUST a line to let you know that thru experience I have found A. C. Plugs to be the most dependable.

I believe them to be a plug which will endure as high a degree of heat as any one could expect of this style of equipment.

APPERSON BROS. AUTOMOBILE CO.



Edgar Apperson

Engineer



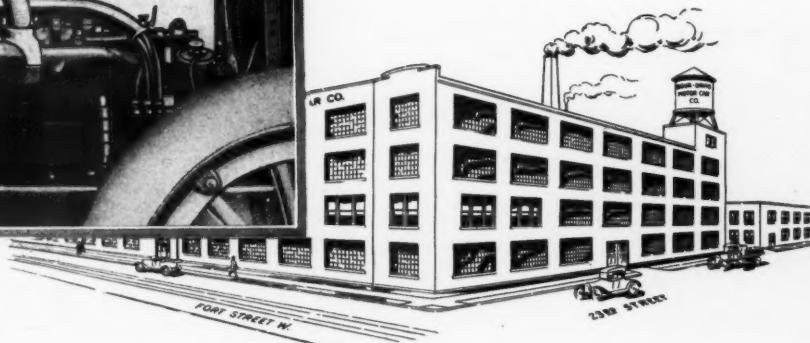
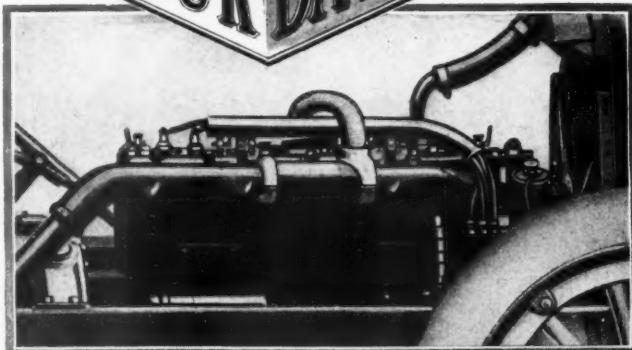
Wm. Ross says:

WE are very exacting in our requirements of parts for Bour-Davis cars and it is a real pleasure to be able to say to you that we have found A. C. Spark Plugs eminently satisfactory throughout.

BOUR-DAVIS MOTOR CAR CO.

Wm. Ross

Chief Engineer



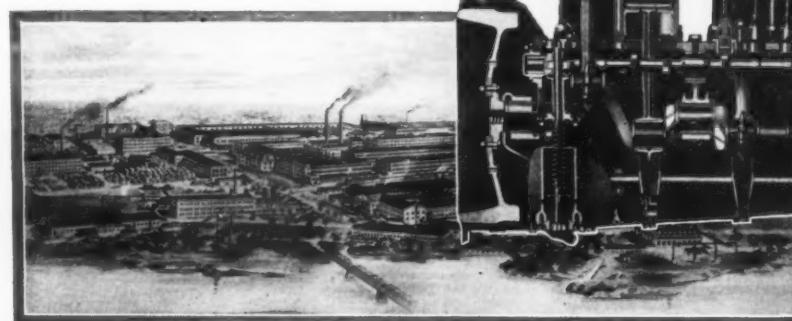
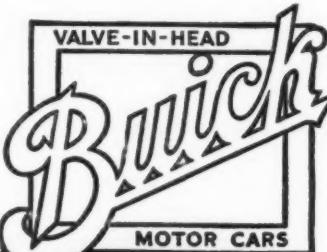


W. P. Chrysler says:

AS pioneer builders of Valve-In-Head Motor Cars, the results our company has obtained in using A-C spark plugs in our motors in the years past have been very gratifying, and we believe that the extremely satisfactory results we have had through using your plugs have been due to your continual advanced research work which has kept your plugs up to the highest possible standard.

BUICK MOTOR COMPANY

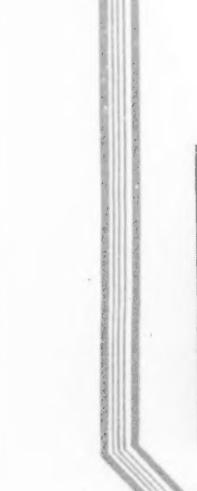
General Manager



E. E. Sweet says:

THE fact that the Cadillac is using and has used A-C spark plugs for four years, coupled with the fact that we aim to always buy the best, not the cheapest, should be enough of a testimonial.

CADILLAC MOTOR
CAR COMPANY

E. E. Sweet
Engineer

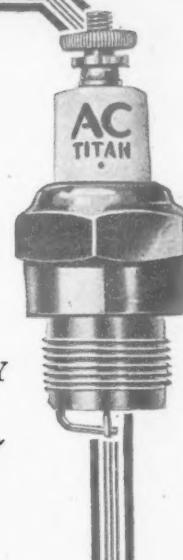
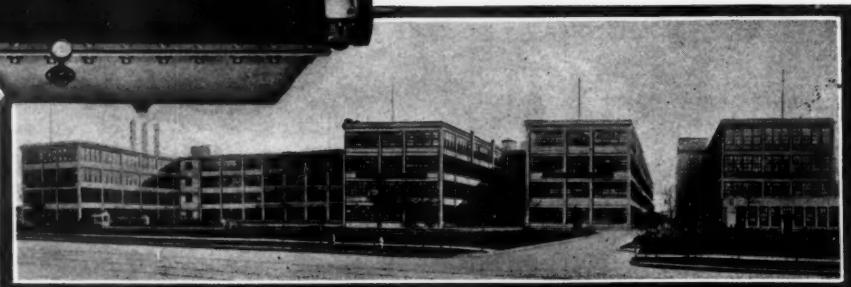
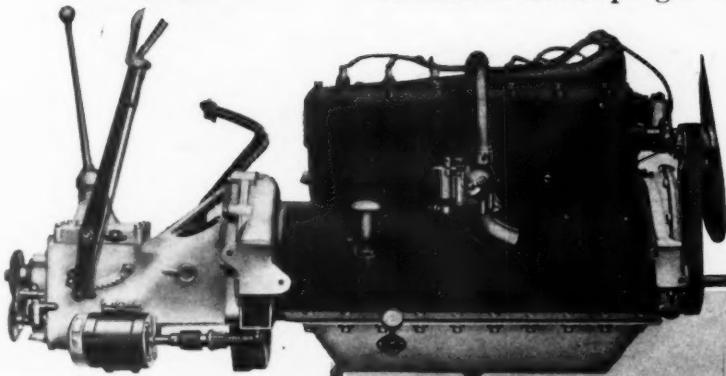


C. C. Hinkley says:

WE have been consistent users of the "AC" plug because we have always felt—and we believe our opinion is based on practice—that the "AC" plug is an all-around, first-class product; and the manufacturers of this plug have been very progressive in their method of developing a better plug every year.

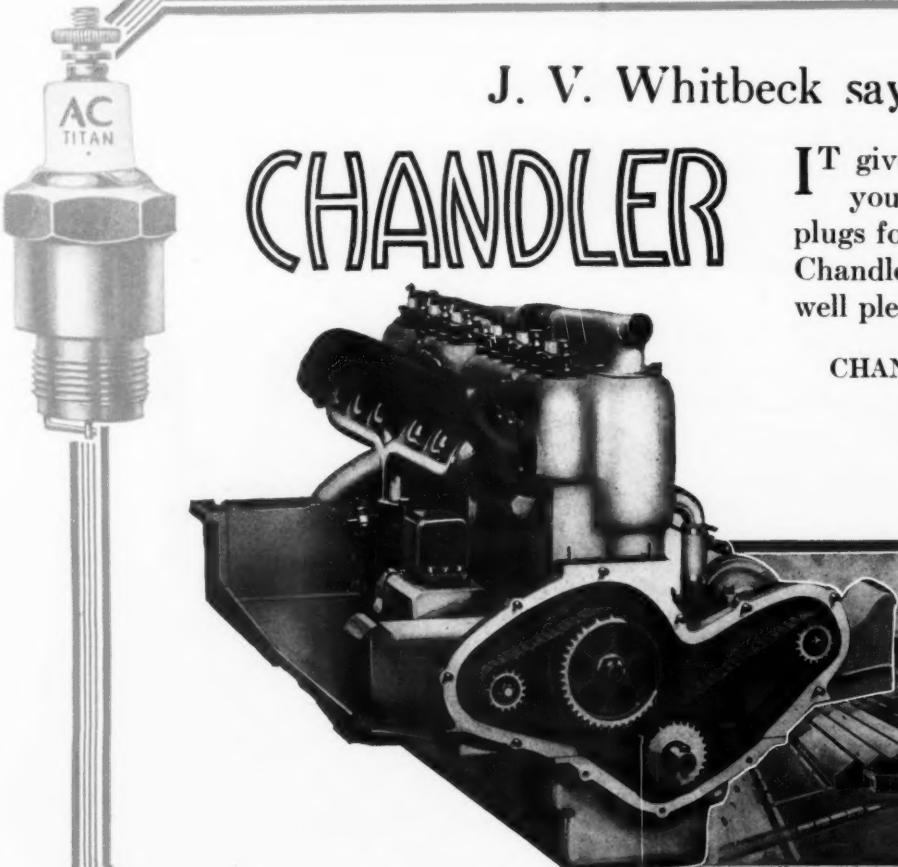
CHALMERS MOTOR COMPANY

C. C. Hinkley
Chief Engineer



J. V. Whitbeck says:

CHANDLER



IT gives me great pleasure to advise you that we have used your spark plugs for the past year and a half on Chandler Light Sixes and have been well pleased with the results.

CHANDLER MOTOR CAR COMPANY

J. V. Whitbeck
Chief Engineer





A. T. Sturt says:

WE have used nearly a million A. C. Spark Plugs! This fact in itself is an unusual tribute, for it proves the truthfulness of each claim you have made for your plugs.

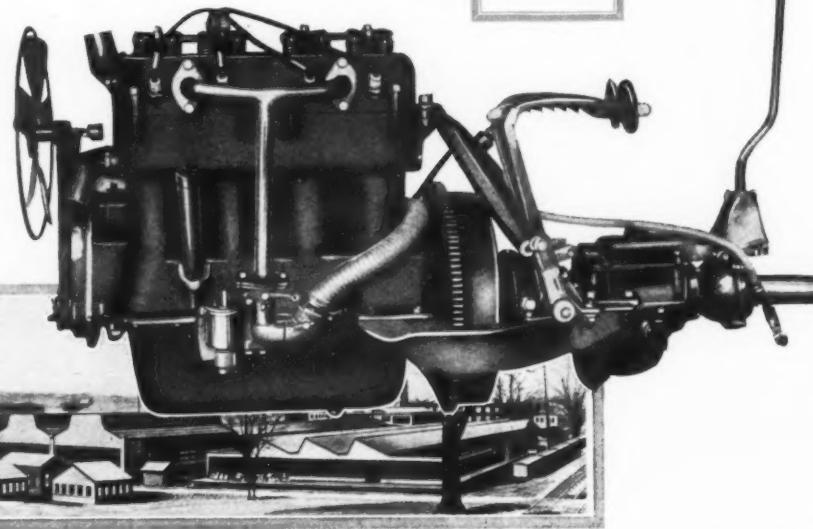
It means complete satisfaction to us and each Chevrolet owner.

A spark plug is small as a mechanical unit, but of vast importance in its function. Its duty is vital. Its action causes the ignition.

And so, the complete satisfaction of A.C. Plugs in over a hundred thousand Chevrolet cars speaks volumes.

CHEVROLET MOTOR CO.

A. T. Sturt
Chief Engineer



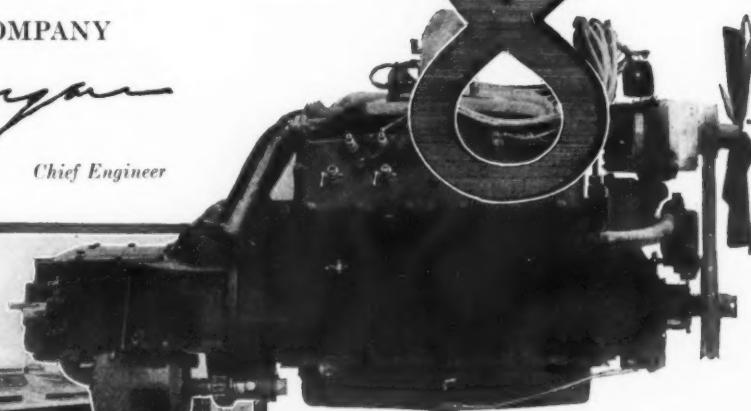
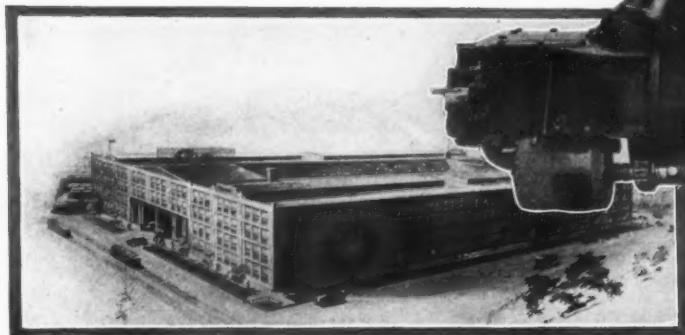
M. B. Morgan says:

YOU have asked me to say a word about A-C Spark Plugs. Don't you think that the fact that we have used them exclusively for three years is more impressive than any written endorsement I might give?

COLE MOTOR CAR COMPANY

M. B. Morgan

Chief Engineer



Chas. H. Tuft says:

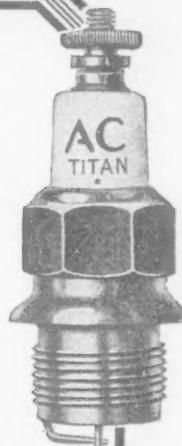
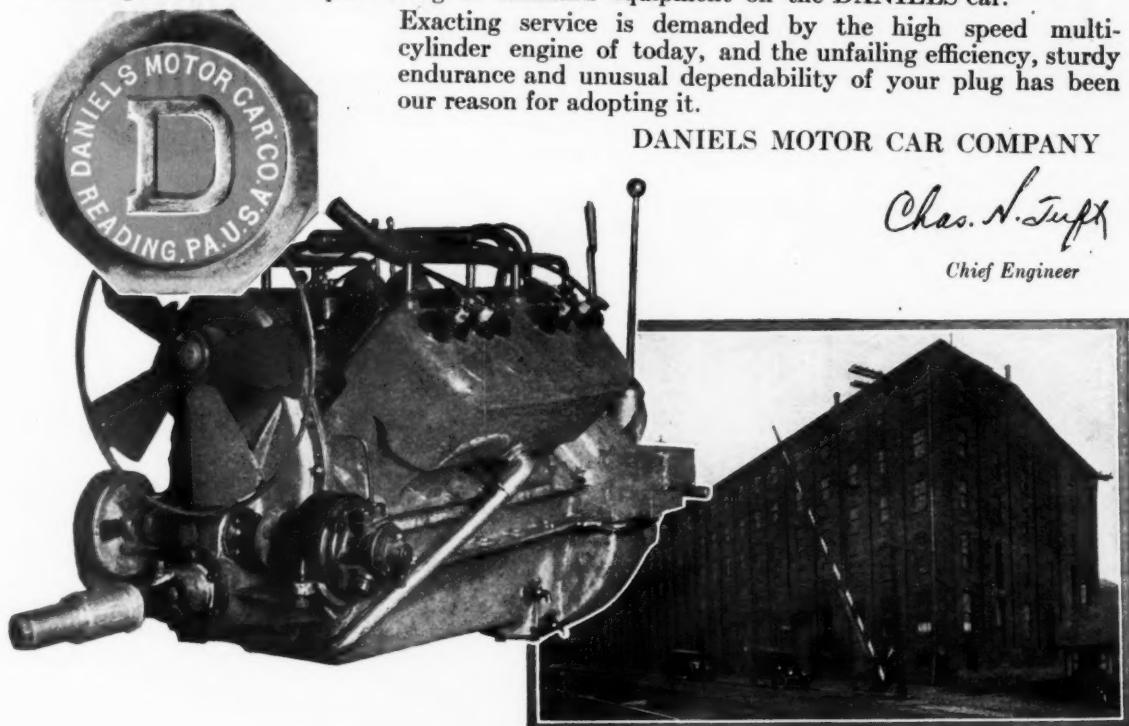
AFTER exhaustive tests of numerous makes of the best plugs on the market, we have adopted the A. C. Spark Plug as standard equipment on the DANIELS car.

Exacting service is demanded by the high speed multi-cylinder engine of today, and the unfailing efficiency, sturdy endurance and unusual dependability of your plug has been our reason for adopting it.

DANIELS MOTOR CAR COMPANY

Chas. H. Tuft

Chief Engineer



W. H. Cummins says:

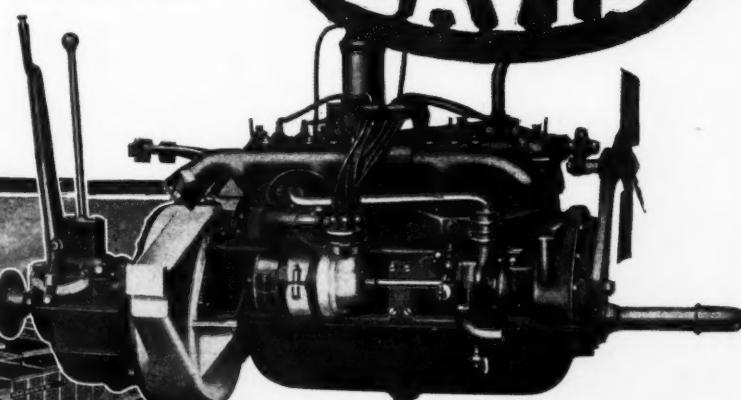
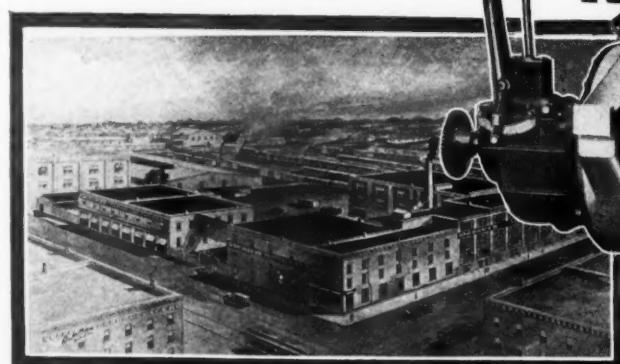
THIS letter is to advise you that we have been using your A. C. Spark Plug for the seasons of 1916 and 1917 and are thoroughly pleased with the results of same and we would be pleased to renew our contract with you for our 1918 requirements.

GEORGE W. DAVIS MOTOR CAR CO.

W. H. Cummins

Treas.

DAVIS





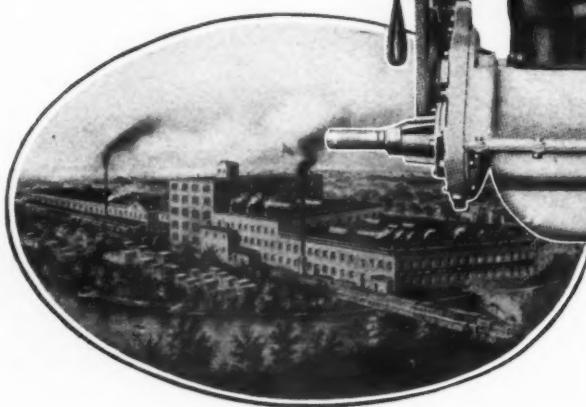
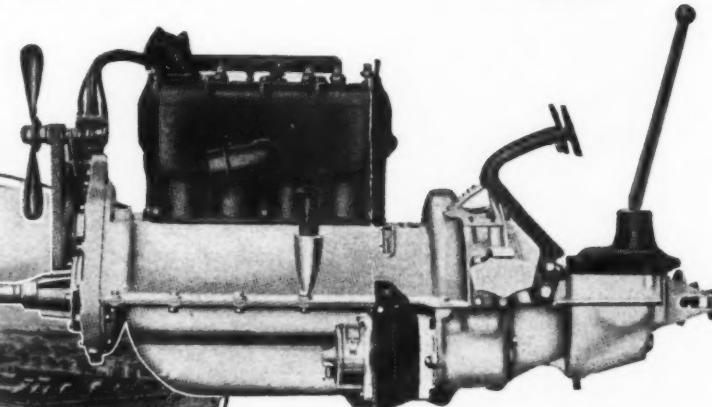
E. Planche says:

I HAVE used successfully the A. C. Spark Plugs in different cars which I have designed and built for the past six years. I am pleased to inform you that I consider your plug a highly scientifically made product, designed and built by the best engineering talent and the best organization in that line.

DORT MOTOR CAR COMPANY



Chief Engineer

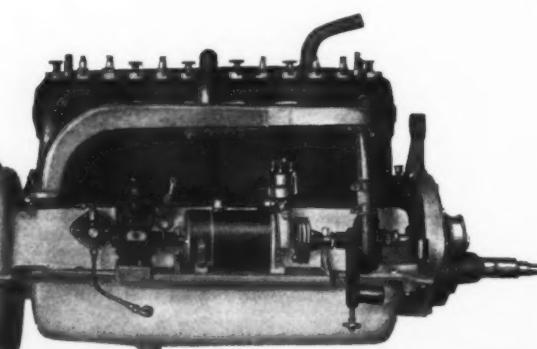
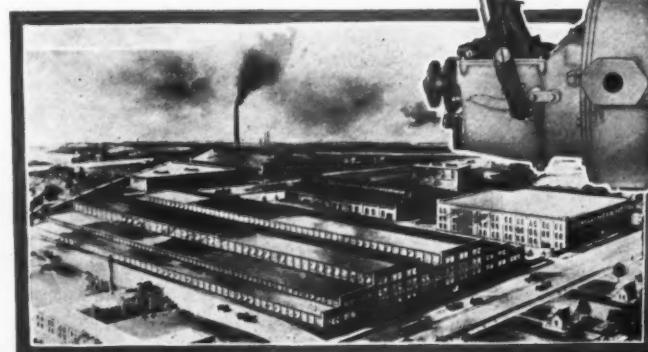


Frank N. Nutt says:

WE have used A. C. Plugs for five years. The service obtained has been most satisfactory.

The consideration and study you give to modern high speed motor designs enables you to produce a plug that will meet any extreme condition.

HAYNES AUTOMOBILE CO.


Chief Engineer

HAYNES



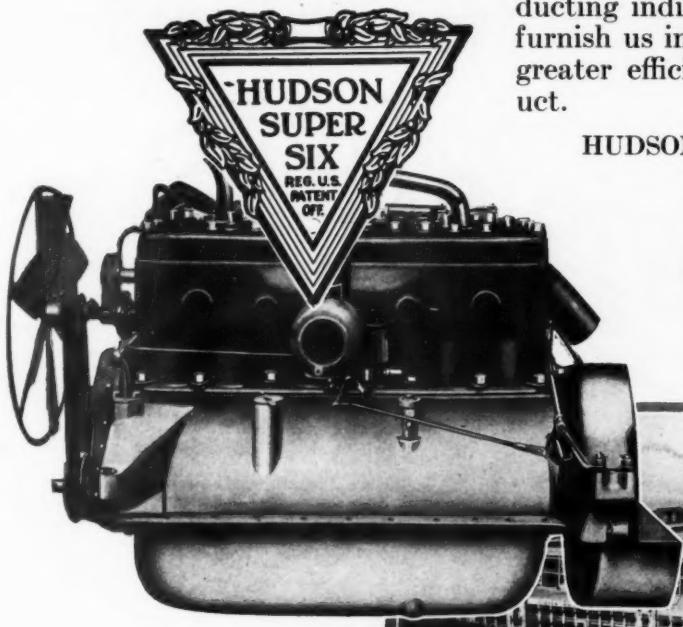
G. G. Behn says:

THE A. C. Spark Plugs which you developed for our Super-Six motor are giving excellent satisfaction. Experiments which we are now conducting indicate that plugs which you will furnish us in the near future will show still greater efficiency than your present product.

HUDSON MOTOR CAR COMPANY



Chief Engineer



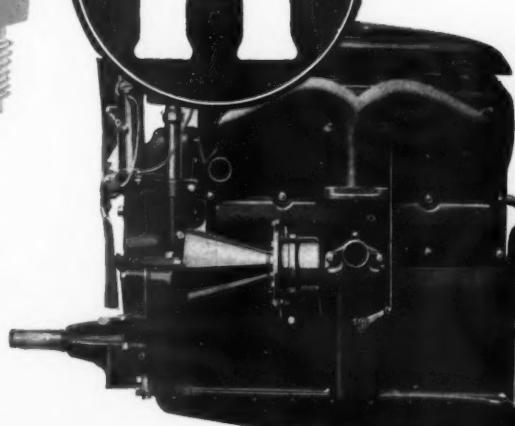
F. E. Watts says:

YOUR company has performed a genuine service to the automobile industry by promoting the general use of the solid type, gas-tight spark plug.

HUPP MOTOR CAR CORPORATION



Chief Engineer





A. A. Bateman says:

IN selecting spark plugs for high speed high compression "Eights," it is a well known fact that care must be taken to get a plug that will stand up under severe tests. Will say that the A. C. Titan, which has been standard in our "Eights," has given the best of satisfaction, and we can heartily recommend it as a plug that can be depended upon to give the best possible results.

JACKSON AUTOMOBILE
COMPANY

A. A. Bateman

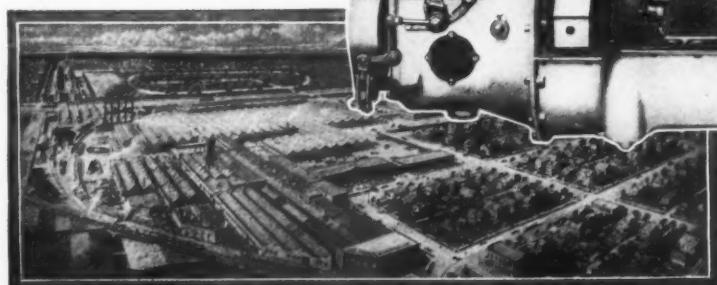
Chief Engineer



C. W. Nash says:

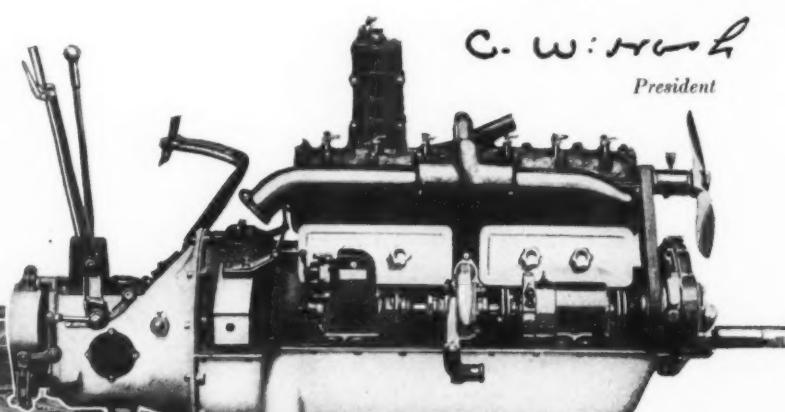
IT affords me a great deal of pleasure to be able to write you to say that I have had very intimate experience with your A. C. Spark Plugs during the past six or seven years, and in my opinion up to the present time there has never been a spark plug made that has been more successful than the A. C. plug for commercial uses.

THE NASH MOTORS COMPANY



C. W. Nash

President



R. S. Begg says:

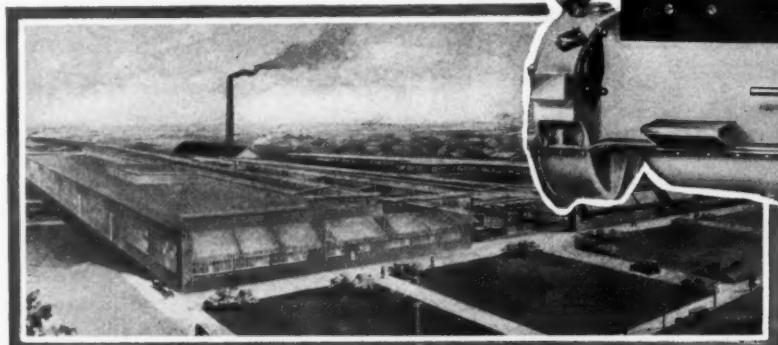
YOU will be interested to learn that we have had universal satisfaction with the A. C. plug, as furnished during the past season and we will undoubtedly obtain the same results during the coming year.

We congratulate you on your splendid product.

JORDAN MOTOR CAR COMPANY



Chief Engineer

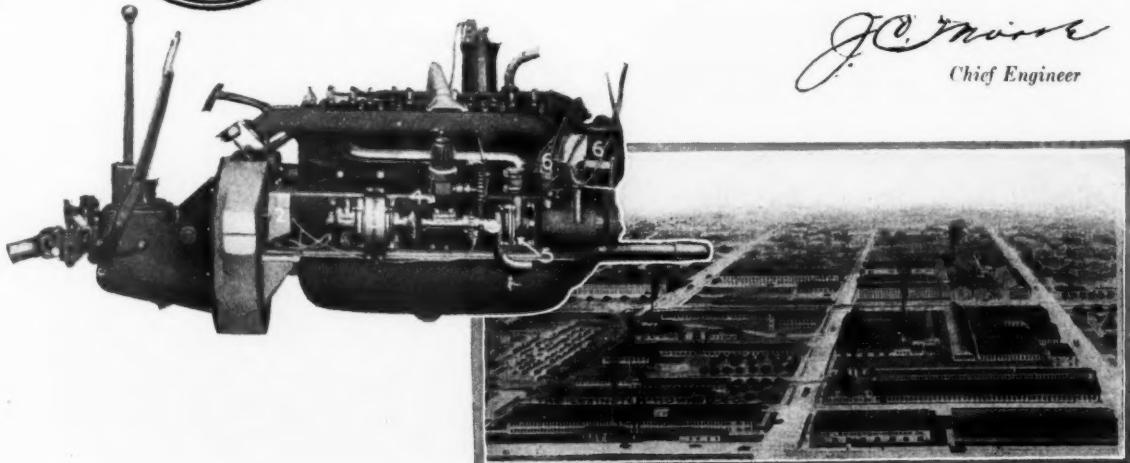


J. C. Moore says:

OUR reason for adopting your A. C. two electrode type of plugs is solely because of the excellent results which we get from this type of plug.

It enables us to cover a greater range of speed from one hundred and fifty up to three thousand R.P.M., with perfect ignition even under wide open throttle, and do not hesitate to say that this is better than anything we have ever tried in the way of a spark plug.

THE LEXINGTON-HOWARD CO.


Chief Engineer

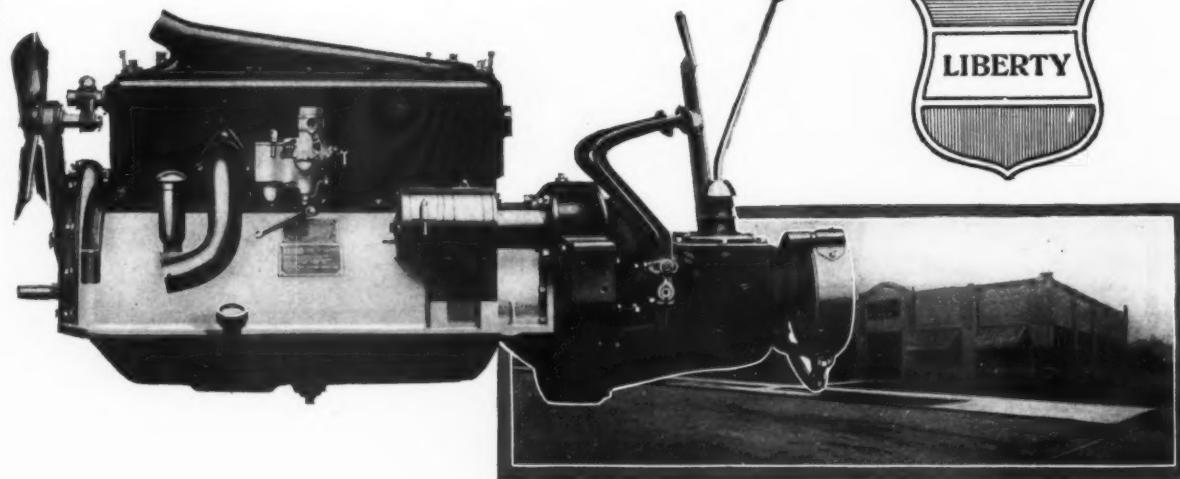
R. E. Cole says:

WE wish to state that the A. C. plugs as used in the Liberty car have proven satisfactory in every respect.

LIBERTY MOTOR CAR COMPANY

R. E. Cole

Chief Engineer



A. L. Riker says:

OUR Engineering Department has conducted a number of tests on A. C. Spark Plugs and the results have been so satisfactory that we have approved this plug as one of our options.

THE LOCOMOBILE COMPANY OF AMERICA

A. L. Riker. Vice-President

Locomobile



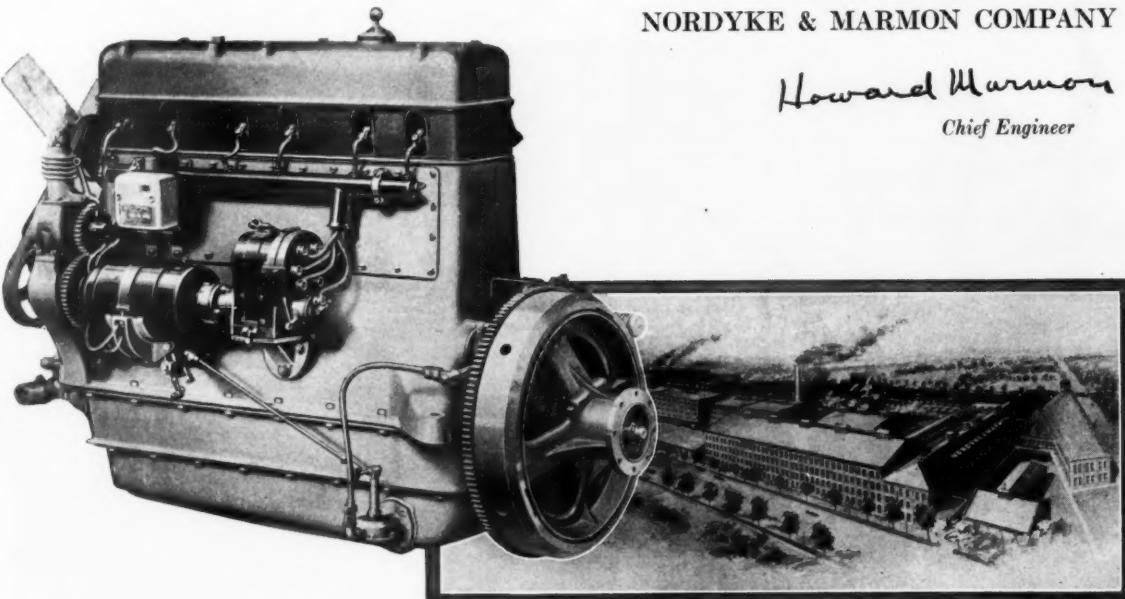


Howard Marmon says:

AFTER using your A. C. plugs for several years as standard equipment we expect to continue their use, as we find them entirely satisfactory.

NORDYKE & MARMON COMPANY

Howard Marmon
Chief Engineer

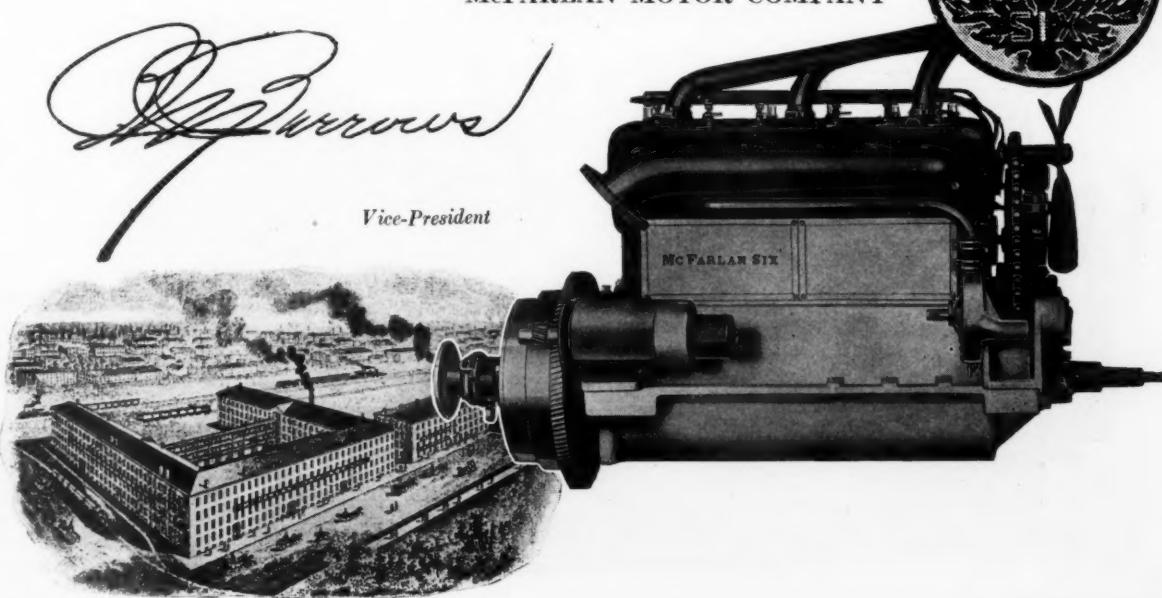


B. M. Barrows says:

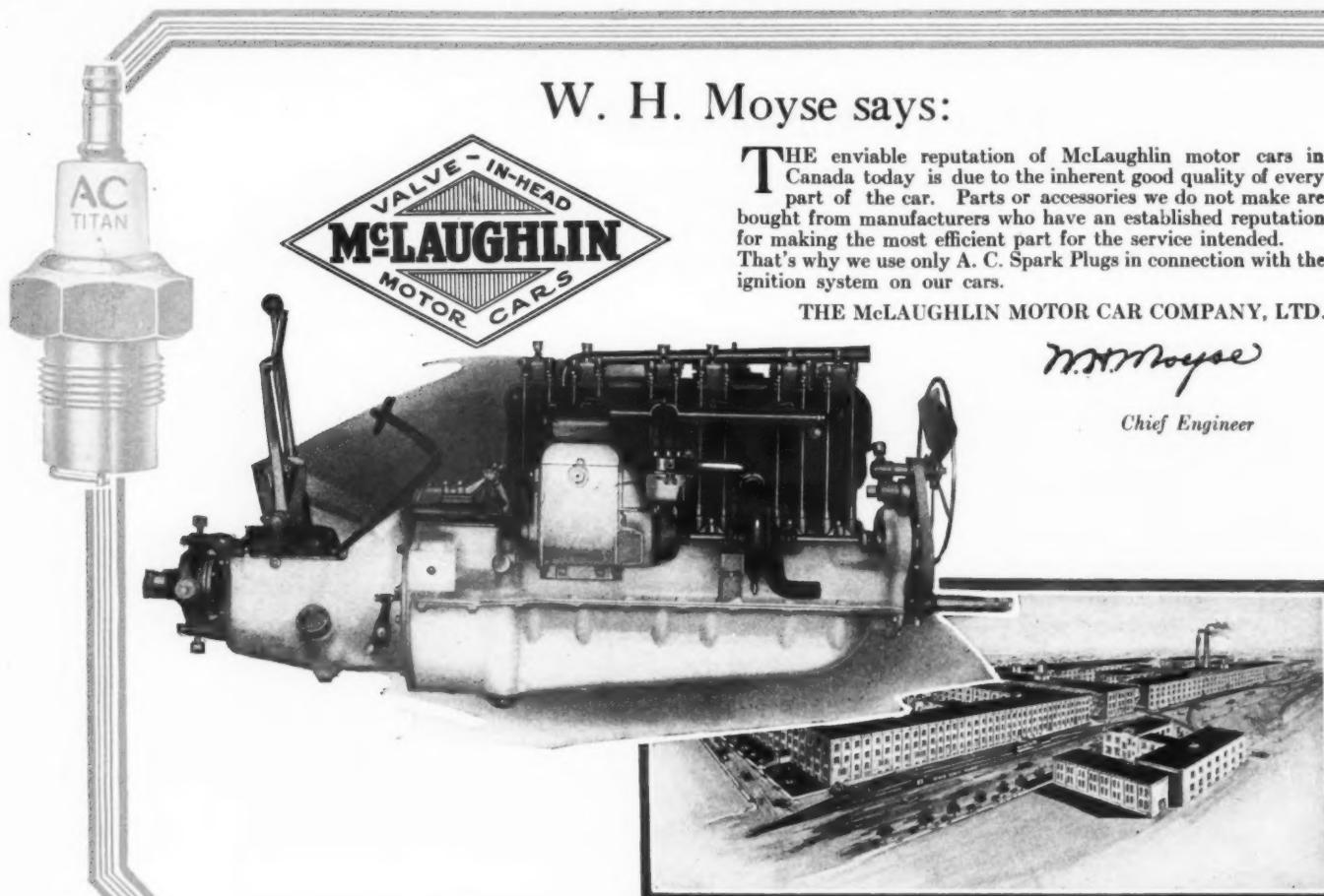
OUR experience with A. C. plugs has been extraordinary. We have used A. C. plugs for the past six years and find that the materials used in their manufacture are absolutely uniform, that the workmanship is exact, and that the spark does not vary. We can get better results with the A. C. plugs than with any other plug we have ever used.

McFARLAN MOTOR COMPANY

B. M. Barrows
Vice-President



W. H. Moyse says:

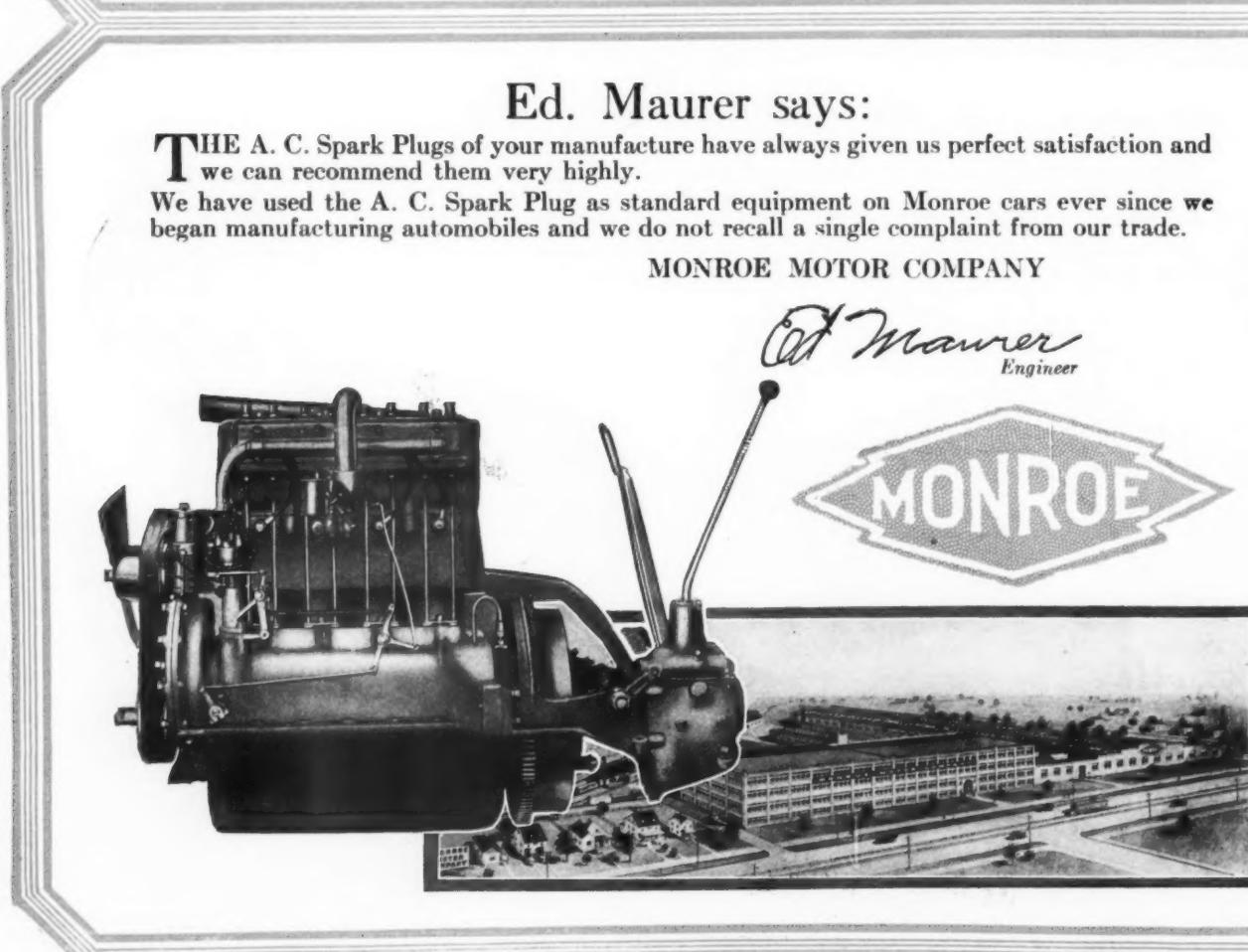


Ed. Maurer says:

THE A. C. Spark Plugs of your manufacture have always given us perfect satisfaction and we can recommend them very highly.

We have used the A. C. Spark Plug as standard equipment on Monroe cars ever since we began manufacturing automobiles and we do not recall a single complaint from our trade.

MONROE MOTOR COMPANY



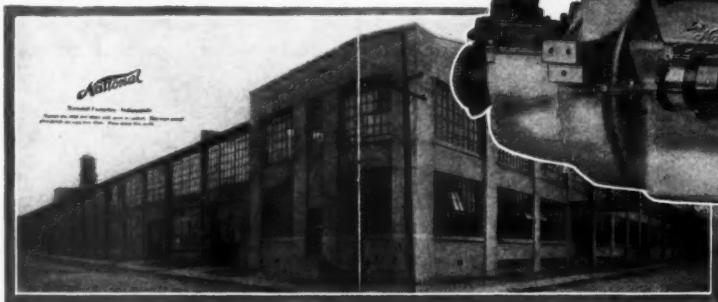
Wm. G. Wall says:

REGARDING conversation with your Mr. Champion yesterday about new type of spark plugs which he is experimenting with, there is no doubt but that the high speed high compression engine and the low grade of gasoline necessitates the use of the best plugs that can be secured. We are continually trying out a good many makes of plugs, but continue to be of the same mind, after using yours for several years, that we can get better results by continuing their use than by purchasing plugs elsewhere. We believe that the satisfactory results we get from your plugs is due greatly to the scientific way in which they are made.

NATIONAL MOTOR CAR & VEHICLE COR'N



Vice-President and Chief Engineer



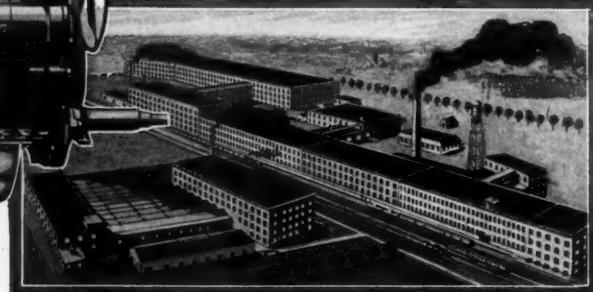
A. C. Hamilton says:

TO produce spark plugs that give uniformly satisfactory results over a wide range of motor speeds, from the very slow idle speeds to the high speed, presents difficulties which I can appreciate; and I am very glad to tell you that A. C. spark plugs on Oakland cars stand up remarkably well under all conditions.

OAKLAND MOTOR CAR CO. OF MICHIGAN



Chief Engineer





F. Sergardi says:

I TAKE pleasure in stating that we have used "AC" Spark Plugs since 1911, on our four, six and eight-cylinder motors and have always found them satisfactory.

OLDS MOTOR WORKS

F. Sergardi
Chief Engineer

J. G. Vincent says:

THE advent of the modern high speed multi-cylinder motor has made it necessary for us to have much better spark plugs. The large amount of research work that has been carried on by the Champion Ignition Company in order to accomplish this result and at the same time make use of domestic materials has been an important contribution to the industry.

PACKARD MOTOR CAR CO.

J. G. Vincent



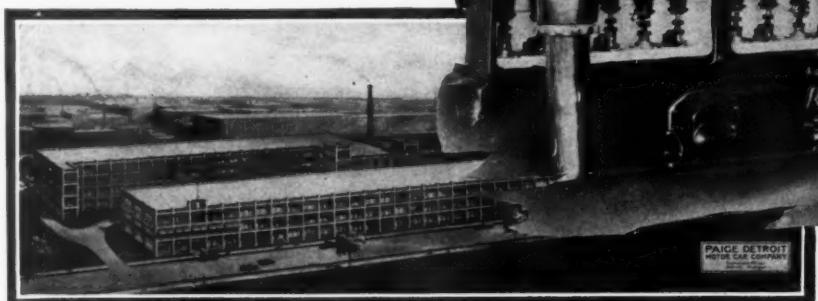
A. Bachle says:

SINCE the adoption as regular equipment of the AC Spark Plugs on Paige motor cars, this feature of motor design has ceased to be a problem in the Paige Engineering Department.

Rigid tests of numerous plugs offered on the market have proven conclusively the superiority of the AC equipment, and just as long as their quality remains the same, they will continue to be placed on all Paige motors.

PAIGE-DETROIT MOTOR
CAR CO.

A. Bachle
Chief Engineer



Karl Feilcke says:

WITH reference to your inquiry of April 5th, have to say that we have been using your "AC" Titan plugs during the past season and that same have given very good satisfaction on our twelve-cylinder motor. It is the plug that has given us all-around best results.

THE PATHFINDER COMPANY

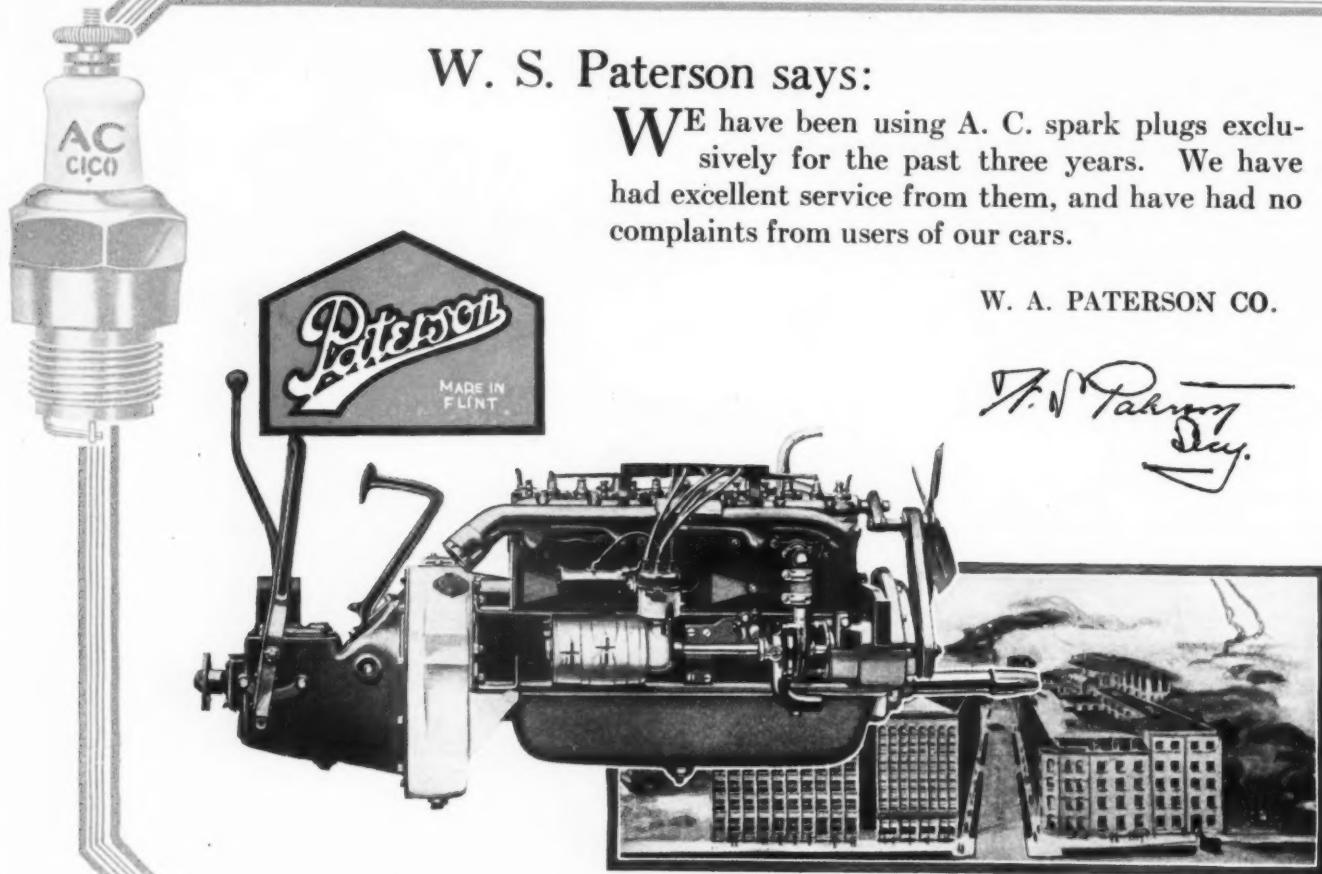
Karl Feilcke
Chief Engineer



W. S. Paterson says:

WE have been using A. C. spark plugs exclusively for the past three years. We have had excellent service from them, and have had no complaints from users of our cars.

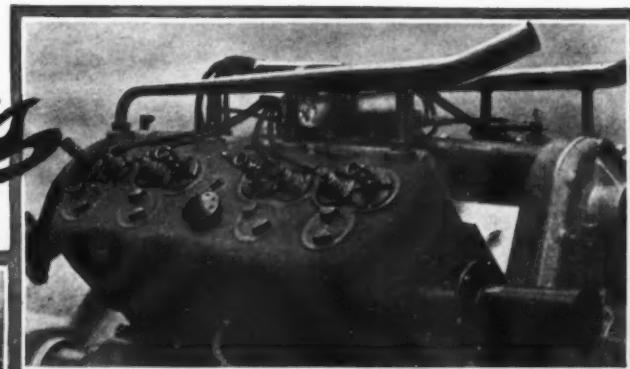
W. A. PATERSON CO.



W. R. Strickland says:

IN adopting your A. C. Titan spark plugs as standard equipment on our eight-cylinder motor, we selected what we believed to be the best all-around commercial plug obtainable, having first subjected the plug to theoretical and scientific bench tests, block tests and road tests, and adopted it for use first on our truck motors, on which they have given great satisfaction. Over 25,000 of these plugs have been shipped to the British War Department on trucks without any but favorable comment.

THE PEERLESS MOTOR CAR CO.

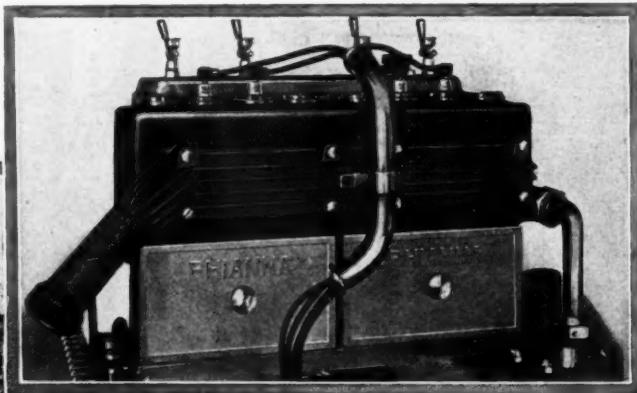

Chief Engineer

M. W. McGaffey says:

WE have been using the A. C. plugs exclusively in our motors and have had practically no trouble with fouling or split porcelains and we find these plugs entirely satisfactory.

PHIANNA MOTORS CO.

M. W. McGaffey, Sept.

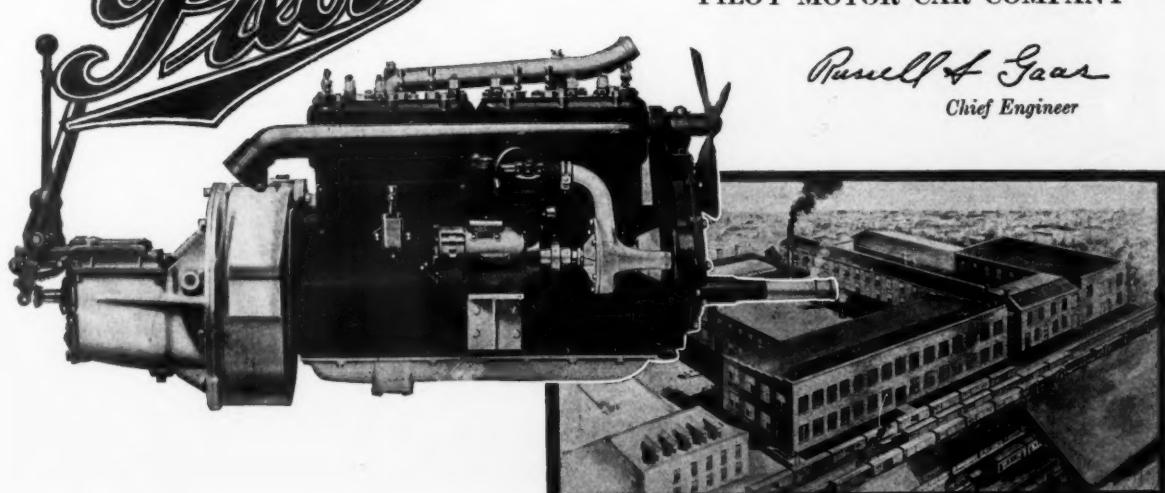


Russell A. Gaar says:

WE are very glad to tell you that during the past five years, in which we have used A. C. plugs exclusively, we have had practically no trouble and we believe them to be the equal, if not the superior, of any plugs on the market. The fact that we have been using them for this length of time is the best evidence that we have not been able to find anything any better. Another point that appeals to us as being of considerable importance is the fact that our dealers all report that very few of their customers change plugs.

PILOT MOTOR CAR COMPANY

Russell A. Gaar
Chief Engineer



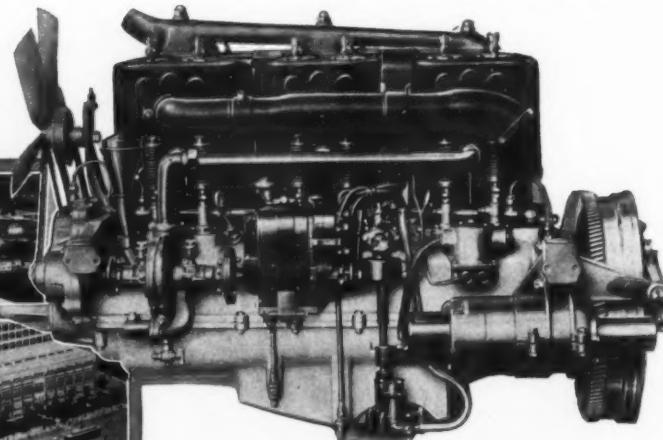


D. Fergusson says:

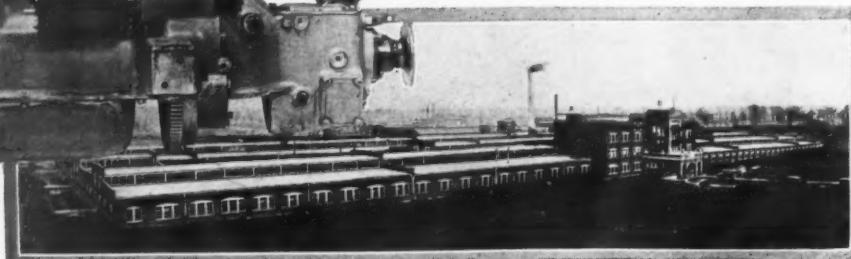
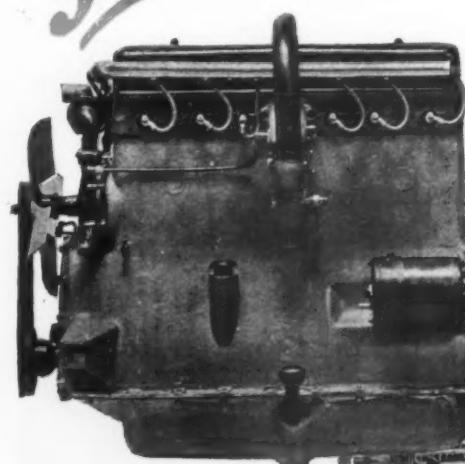
YOU certainly should be congratulated on manufacturing a spark plug that gives such satisfaction. This was our only reason for adopting it, the price of this very important accessory having no influence with us.

THE PIERCE-ARROW MOTOR CAR COMPANY

Chief Engineer Pleasure Car Department



Premier



E. G. Gunn says:

OUR experience with car owners and high speed work on Speedway has convinced us that your "AC" Titan has no equal for satisfactory service in our Over-Head Valve Aluminum Motor.

PREMIER MOTOR CORPORATION

Chief Engineer

H. T. Thomas says:

REPLYING to your letter of April 26th, concerning your A-C Spark Plugs, will state that we have used this plug as standard equipment for the past two years, are very well pleased with same and have no criticisms to make.

REO MOTOR CAR COMPANY

H. T. Thomas

Engineer



W. H. Knowles says:

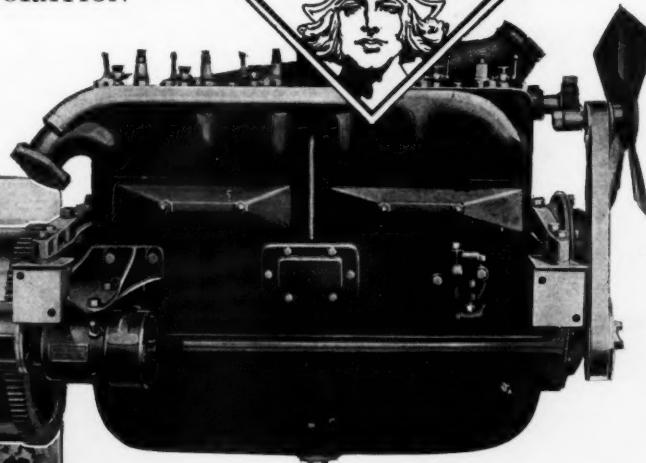
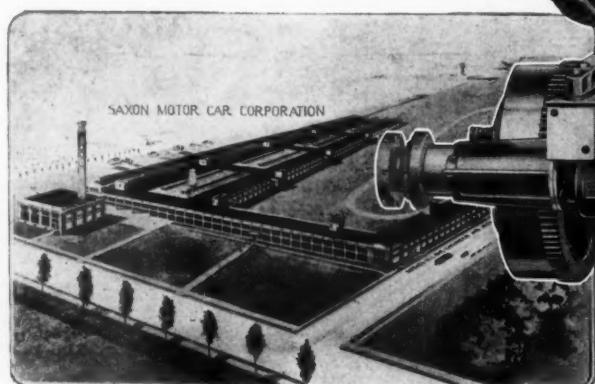
WE are using the A.C. Spark Plug on Saxon cars after thoroughly testing these for use on our high-speed motors and we have found they give very satisfactory performance.

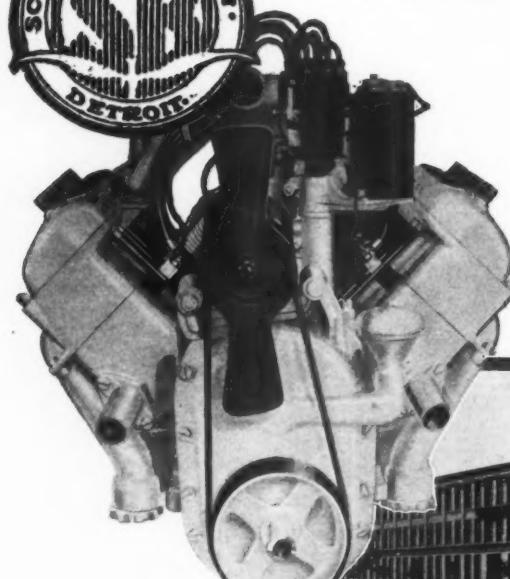
SAXON MOTOR CAR CORPORATION

W. H. Knowles

Chief Engineer

SAXON
Strength-Economy-Service





H. O. C. Isenberg says:

IT certainly is a pleasure to state that from a great many tests carried out with spark plugs on various motors, including multiple cylinder "V" type engines, I have found the "AC Titan" plug to be the most satisfactory and reliable one now on the market. Among all spark plugs, a "TITAN" in every true sense of the word.

We are pleased to advise that the SCRIPPS-BOOTH CORPORATION is using the "AC Titan" spark plug as standard equipment on both of their 1917 Models.

SCRIPPS-BOOTH CORPORATION

A handwritten signature of H.O.C. Isenberg.

Chief Engineer

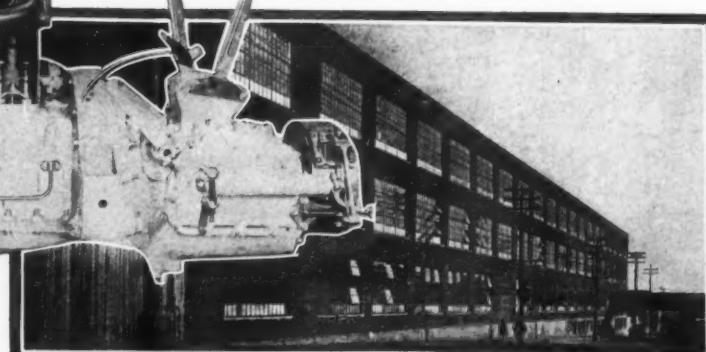
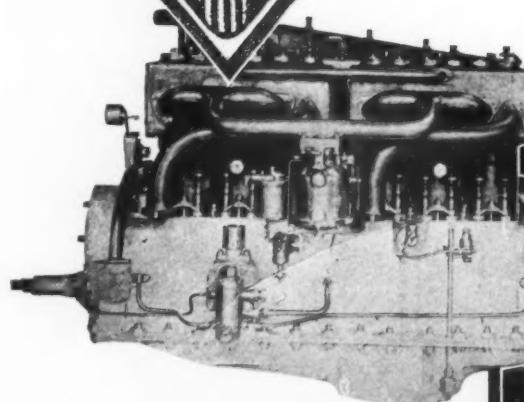


H. M. Crane says:

I AM pleased to tell you that the A. C. plugs have given very satisfactory service in our motors.

A handwritten signature of H.M. Crane.

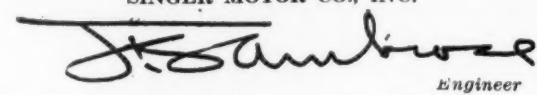
Vice-President



F. S. Ambrose says:

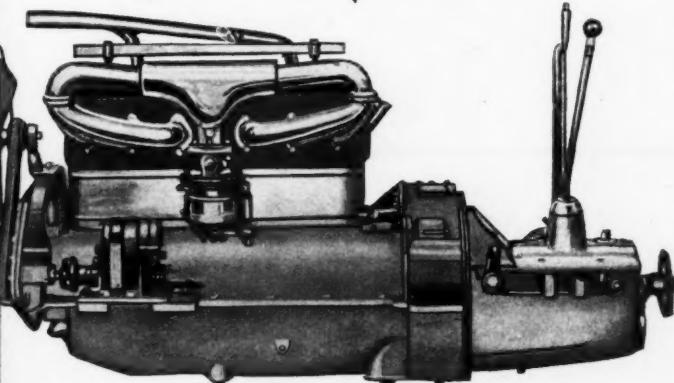
WE have been watching very closely the performances of the AC spark plugs which we are using as standard equipment, and have been for the past few seasons. I must say that we find these plugs to be O. K. in every respect. We have no trouble with leaky joints or cracked porcelains, and once the plugs are adjusted and put in place, they give us no further trouble.

SINGER MOTOR CO., INC.


F. S. Ambrose
Engineer



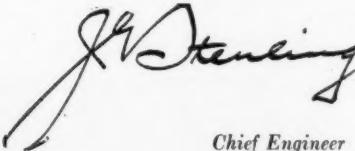
Singer



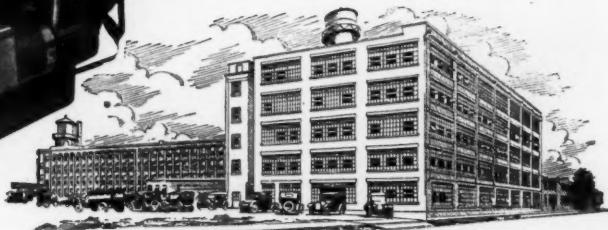
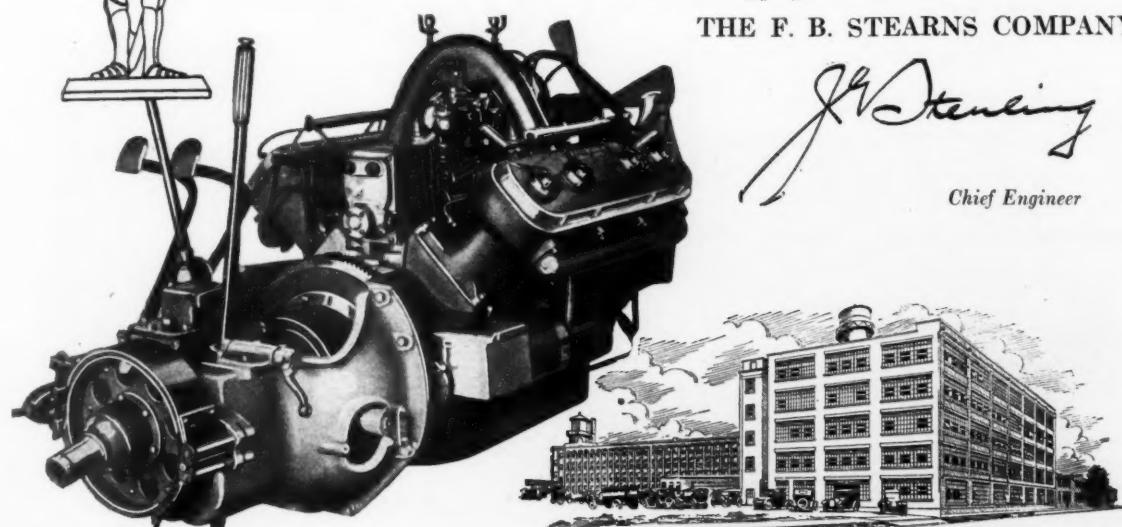
J. G. Sterling says:

YOUR plugs are standard equipment in both our four and eight-cylinder Knight type motors. We test these motors by long runs under full load and the plugs show particularly to advantage under this service.

THE F. B. STEARNS COMPANY


J. G. Sterling

Chief Engineer





H. C. Stutz says:

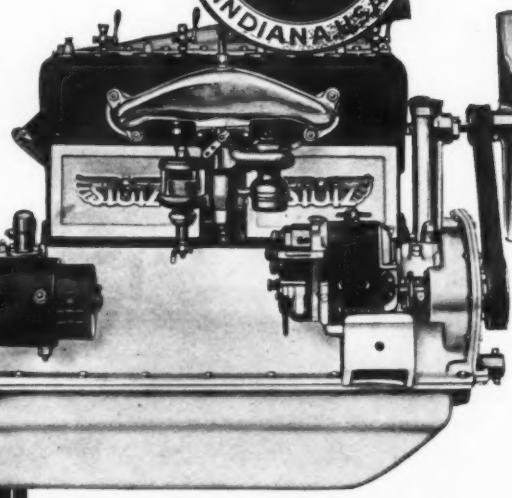
WE have used your AC-Titan plugs for the past two years and we wish to congratulate you on the service which these plugs have given us.

We know of none better.

STUTZ MOTOR CAR COMPANY

The signature of H. C. Stutz, written in a flowing cursive script.

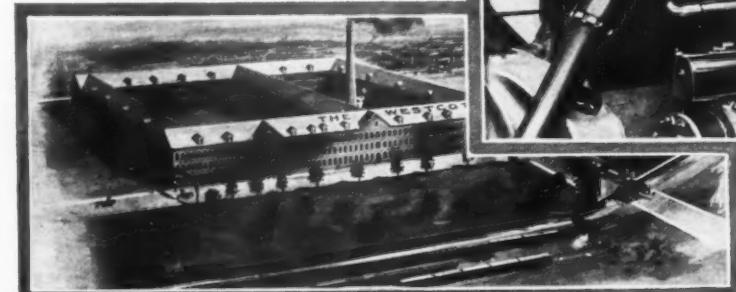
President and General Manager



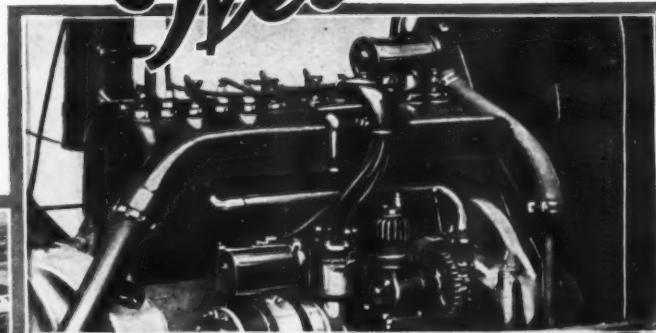
E. R. Martin

Chief Engineer

THE WESTCOTT MOTOR CAR CO.

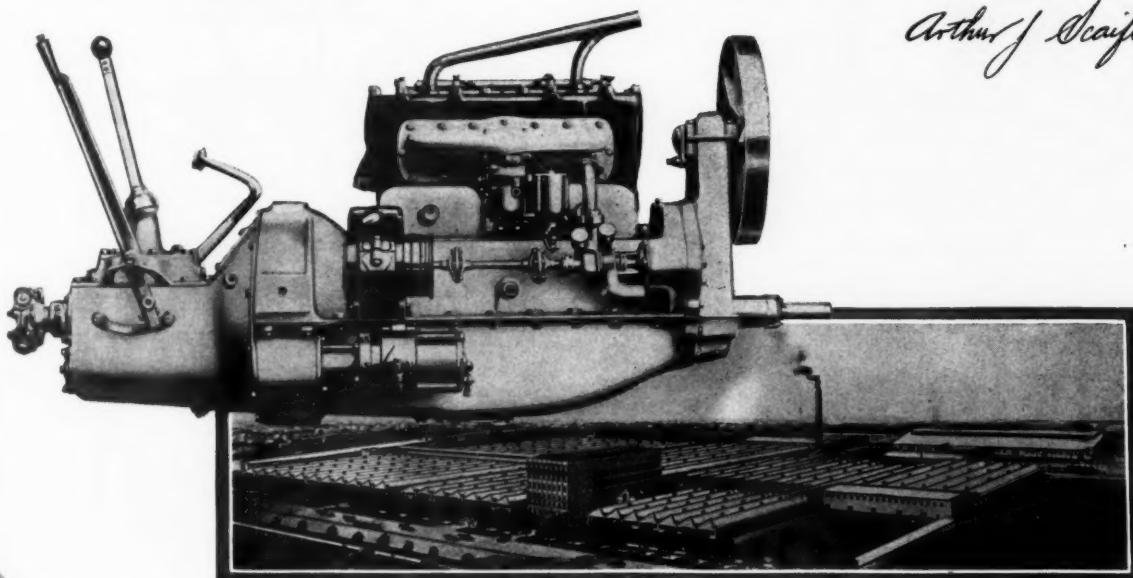


The signature of E. R. Martin, written in a flowing cursive script.





WHITE 16 Valve 4



Arthur J. Scaife says:

IN regard to the conversation the writer had with you recently at the factory, wish to advise that we are using your spark plugs in our 6-valve engines and we find them to give good results and are satisfactory in every way.

THE WHITE MOTOR COMPANY

Arthur J. Scaife.



Ellis G. Malpas says:

IN building the Acme, "The Truck of Proved Units," why do Acme engineers use the Continental Motor,—or Timken Axles?

Because we feel that no other motor manufacturer makes a better motor than the Continental, nor is any other axle maker furnishing a better axle than the Timken.

And the same principle applies to the A C plug. The A C Titan has practically eliminated all of our plug trouble. We have found that it is made of the right kind of material, of the proper size, and is properly crimped, avoiding gas leaks and cracked porcelain.

CADILLAC AUTO TRUCK COMPANY

Ellis G. Malpas.
Engineering Department



P. J. F. Batenburg says:

AFTER careful investigation of the different spark plugs used on our cars in actual service, we have decided to use AC plugs as standard.

FOUR WHEEL DRIVE AUTO CO.



Chief Engineer

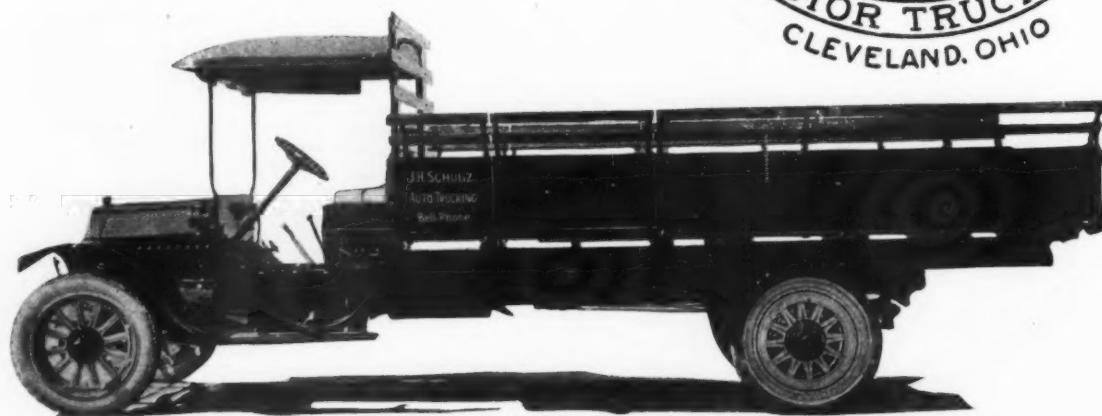
F
W
D



Chas. E. Hall says:

AFTER carefully trying out different makes of spark plugs, we have decided upon using your "AC" Titan plug for our regular equipment, as we believe it is the only plug which will compare favorably with the balance of the well known units composing our truck all of which have been selected after careful consideration.

THE GABRIEL MOTOR TRUCK CO.


Manager

F. A. Whitten says:

WE have used AC plugs exclusively for five years. During this time we have sold many thousands of trucks fitted with them.

Due to more hours of service per day and greater gear reductions, spark plugs in trucks get not less than six times as much service per year as do those of passenger cars.

In spite of this severe work we have had splendid service from AC plugs and they are well liked by our customers and our Service Department.

GENERAL MOTORS COMPANY



F. A. Whitten Chief Engineer



R. W. Austin says:

THE day in and day out service given by A. C. Plugs fits in well with the severe conditions which the Gramm-Bernstein trucks meet in every line of work.

GRAMM-BERNSTEIN MOTOR TRUCK CO.

R. W. Austin

Chief Engineer





G. M. Evans says:

WE have canvassed the country for a quality spark plug, and after a thorough tryout, our choice has been AC plugs.

MENOMINEE MOTOR TRUCK COMPANY

John Evans
Manager

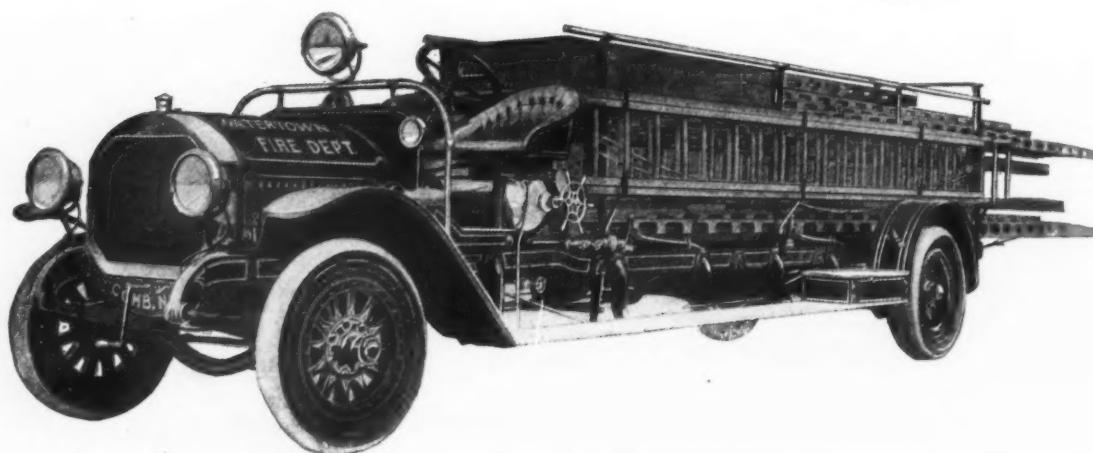


C. A. Carey says:

OUR experience with AC plugs has been very satisfactory especially on our motor driven fire pumps where high efficiency is called upon from every part.

MAXIM MOTOR COMPANY

C. A. Carey
Mech. Eng.



John Wiggers says.

IN reply to yours of recent date regarding the service given by A. C. spark plugs, wish to say that these plugs have given us entire satisfaction.

We consider the spark plug one of the most vital parts of the power plant, and in selecting A. C. spark plugs as standard equipment, for the year 1917, on Moreland Motor Trucks, we have done so only after testing several makes, and finding the quality of A. C. spark plugs to be fully up to our requirements.

MORELAND MOTOR TRUCK CO.

MORELAND
Distillate Motor Trucks

John Wiggers
Chief Engineer



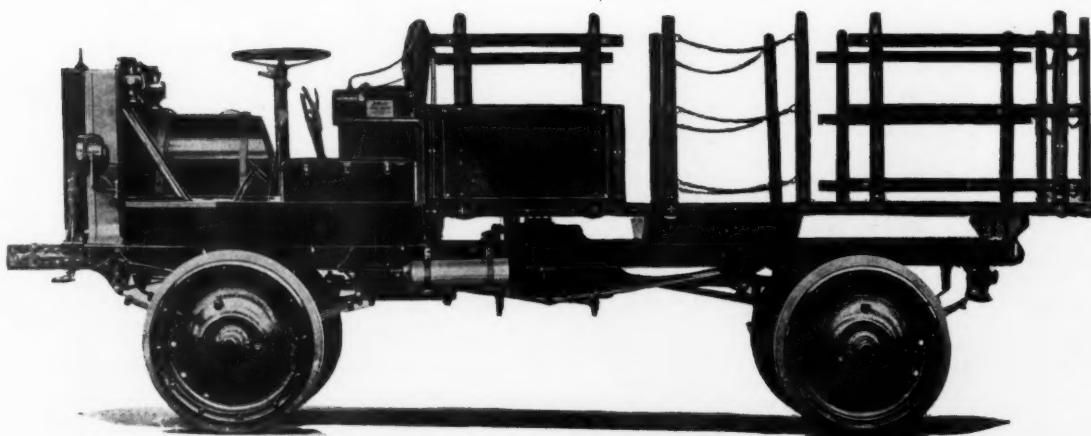
C. W. Nash says:

IT affords me a great deal of pleasure to be able to write you to say that I have had very intimate experience with your "AC" spark plugs during the past six or seven years, and in my opinion up to the present time there has never been a spark plug made that has been more successful than the "AC" plug for commercial uses.

NASH
Jeffery
MOTORS

THE NASH MOTORS COMPANY

C. W. Nash
President





F. S. Suthergreen says:

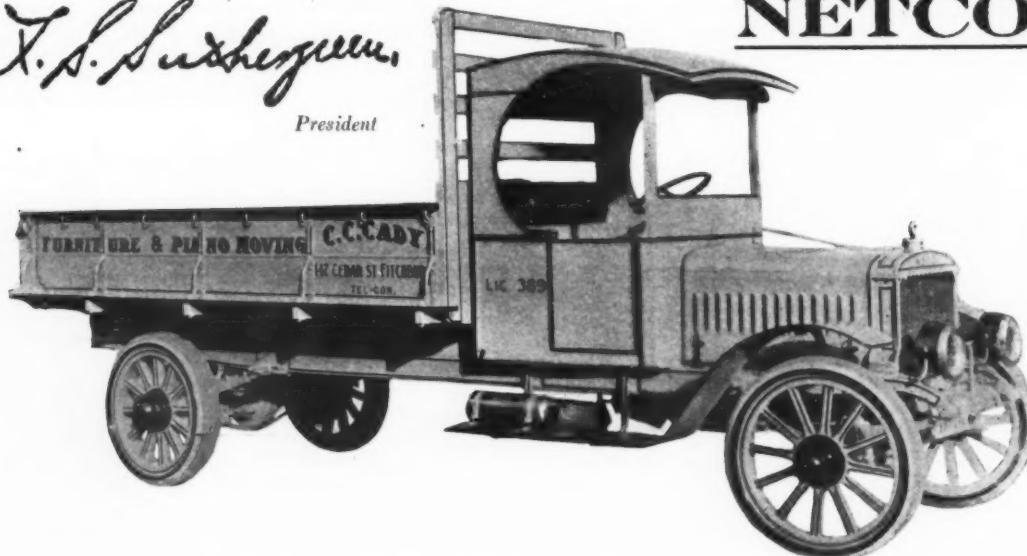
IT will doubtless interest you at this time to know that our Netco trucks are performing so uniformly with your plugs, that we have placed our order for our entire next year's equipment.

NEW ENGLAND TRUCK COMPANY

F. S. Suthergreen.

President

NETCO



L. G. Bartlett says:

WE use "AC" plugs for two virile reasons. Consistency with our selling policy, "Most for the money," and consistency with our production slogan—"The one truck worthy of that name."

"OLD RELIABLE" MOTOR TRUCK CO.

L. G. Bartlett.

Chief Engineer

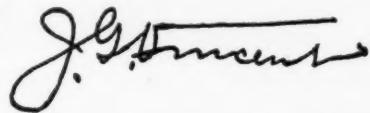
Old Reliable



J. G. Vincent says:

THE advent of the modern high speed multi-cylinder motor has made it necessary for us to have much better spark plugs. The large amount of research work that has been carried on by the Champion Ignition Company in order to accomplish this result and at the same time make use of domestic materials has been an important contribution to the industry.

PACKARD MOTOR CAR CO.



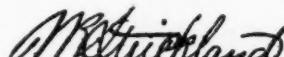
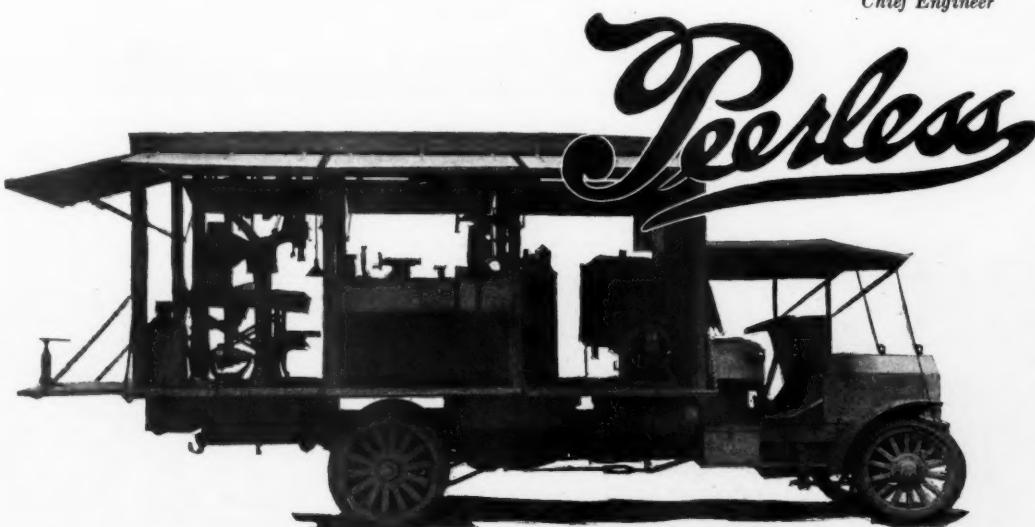
Packards



W. R. Strickland says:

IN adopting your A. C. Titan spark plugs as standard equipment on our eight-cylinder motor, we selected what we believed to be the best all-around commercial plug obtainable, having first subjected the plug to theoretical and scientific bench tests, block tests and road tests, and adopted it for use first on our truck motors, on which they have given great satisfaction. Over 25,000 of these plugs have been shipped to the British War Department on trucks without any but favorable comment.

THE PEERLESS MOTOR CAR COMPANY


W. R. Strickland
Chief Engineer



John Younger says:

WE have been using A-C plugs on our trucks for this last two years. They are very successful and show up better all around than any other plug we have been able to find.

THE PIERCE-ARROW MOTOR CAR COMPANY



John Younger
Chief Engineer Truck Department



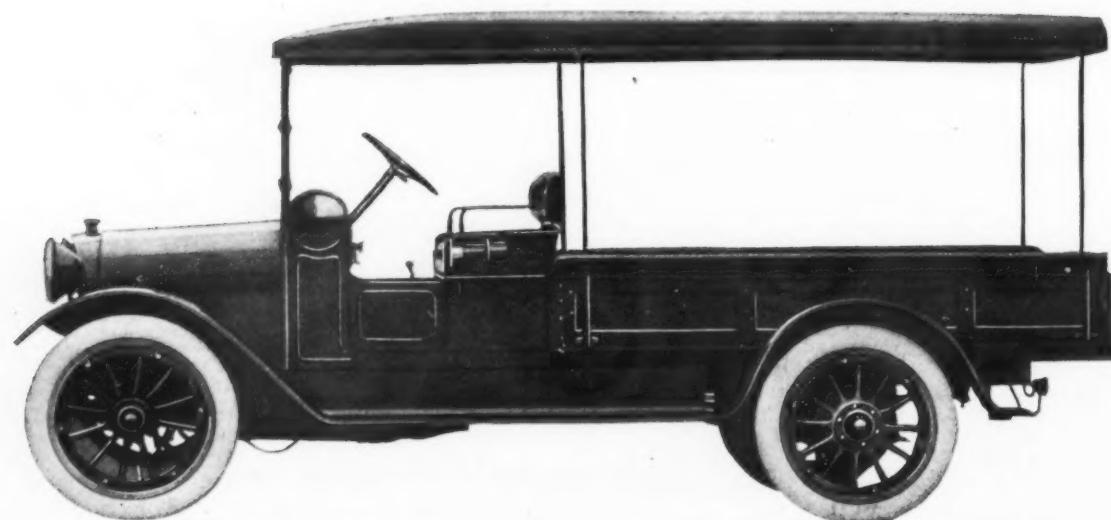
H. T. Thomas says:

REPLYING to your letter of April 26th, concerning your A-C Spark Plugs, will state that we have used this plug as standard equipment for the past two years, are very well pleased with same and have no criticisms to make.

REO MOTOR CAR COMPANY



H.T. Thomas
Engineer



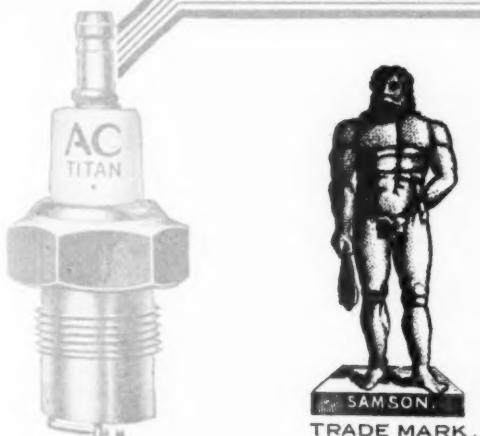


A. L. Riker says:

OUR Engineering Department has conducted a number of tests on AC Spark Plugs and the results have been so satisfactory that we have approved this plug as one of our options.

THE LOCOMOBILE COMPANY OF AMERICA

A. L. Riker.
Vice-President

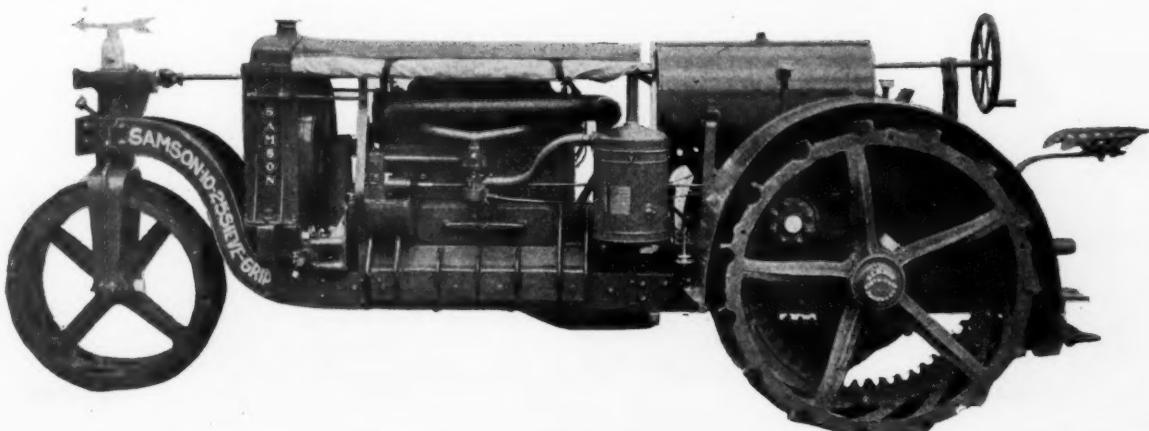


G. F. Lambert says:

WE have been using AC Plugs for some time on our Samson Sieve-Grip farm tractors and the results have been excellent. Probably no form of motor ignition is more trying on spark plugs than that of farm tractors. Their constant exposure to dust, heat, rain, etc., necessitates a high quality of material in all their parts and peculiarly so in regard to spark plugs.

SAMSON SIEVE-GRIP TRACTOR CO.

G. F. Lambert
Chief Engineer



John Squires Says:

IN response to your inquiry as to the performance we have been getting from your spark plugs, it is reported to us by our Road Testing Department that it has not been necessary for them to replace a single plug for any reason whatever for the past ninety days, to the extent of recollection of the present head of that Department.

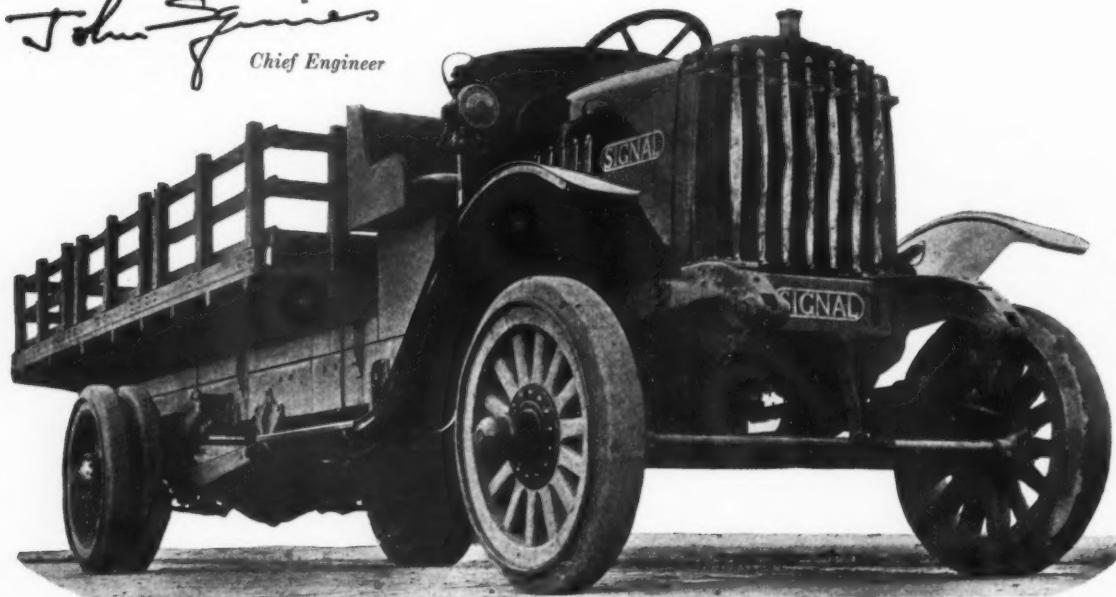
Considering the extremely diverse conditions of operation which exist in truck road testing, this record is remarkable and unprecedented.

SIGNAL MOTOR TRUCK COMPANY

John Squires
Chief Engineer



SIGNAL



Arthur C. Wollensak Says:

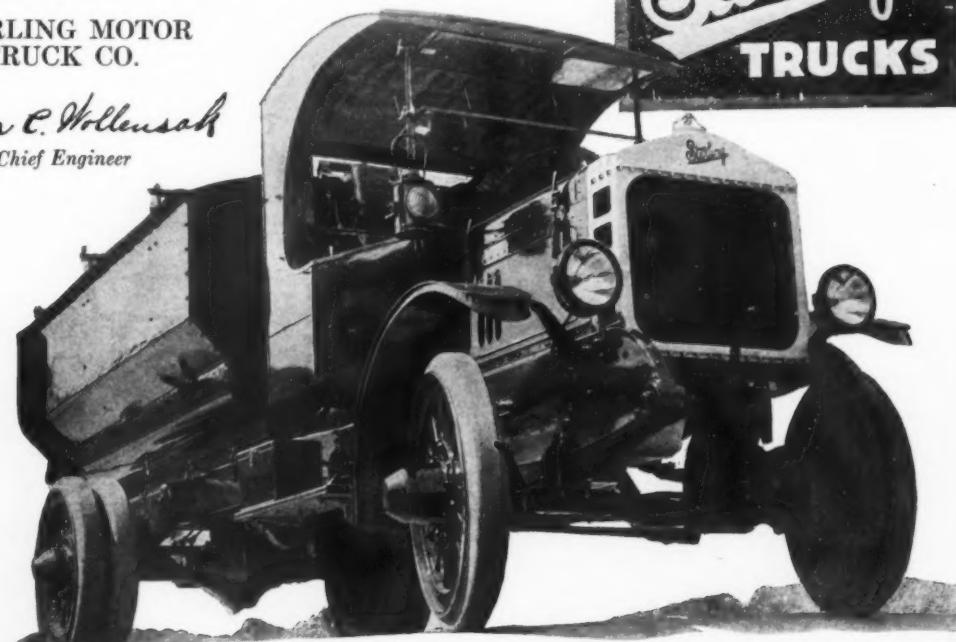
OUR experience with the A C Titan spark plugs has demonstrated that they are all that could be desired for heavy duty truck work.

STERLING MOTOR
TRUCK CO.

Arthur C. Wollensak
Chief Engineer



Sterling
TRUCKS



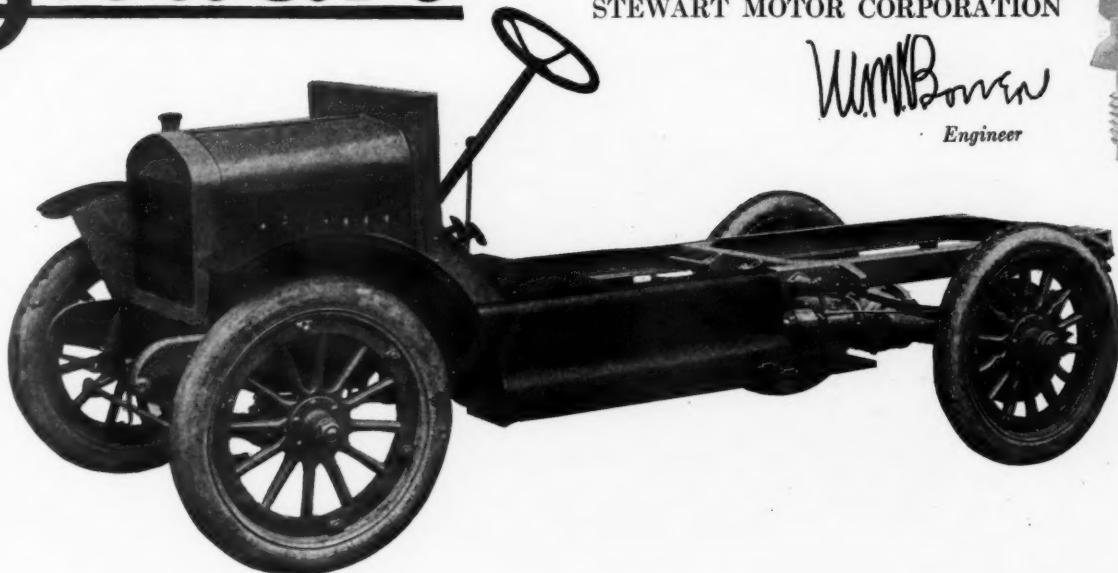
Wm. Bowen says:

Stewart

After exhaustive tests we have adopted "AC" Plugs as standard equipment on Stewart trucks.

STEWART MOTOR CORPORATION

Wm. Bowen
Engineer



E. H. Farmer says:

OUR experience with AC plugs has extended over a period of five years, during which time we have enjoyed great success. We recommend your AC or "always clean" plug wherever a heavy duty and dependable plug is desired.

H. E. WILCOX MOTOR CO.

E. H. Farmer
Engr. Dept.

WILCOX TRUX



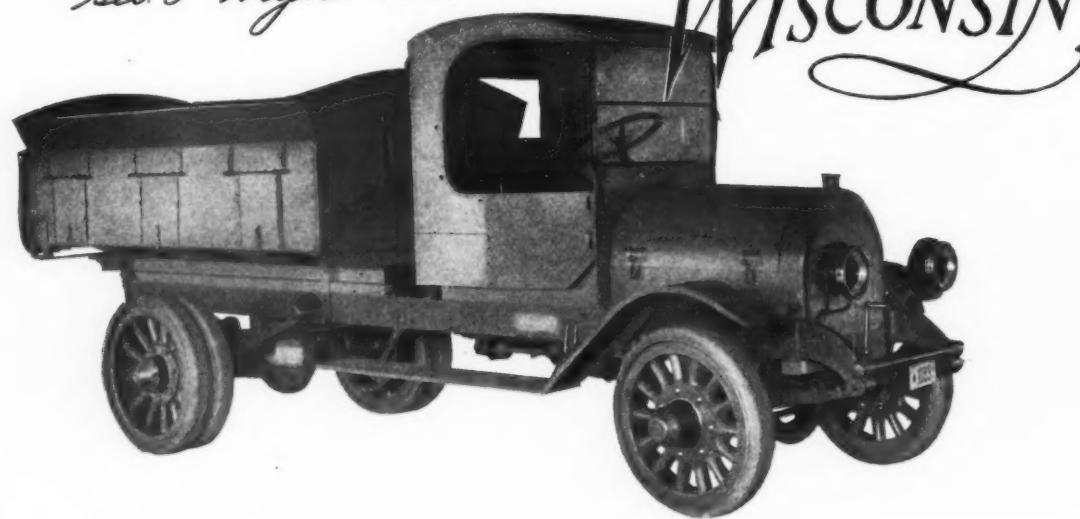


Geo. P. Myers says:

REPLYING to your letter of April 11th in regard to your Spark Plugs. We have used your Plugs exclusively on all of our trucks manufactured by us up to the present and have just placed an order for a new lot of your AC Titan Spark Plugs. We have had no trouble with your plugs up to the present time.

MYERS MACHINE CO.

Geo. P. Myers President



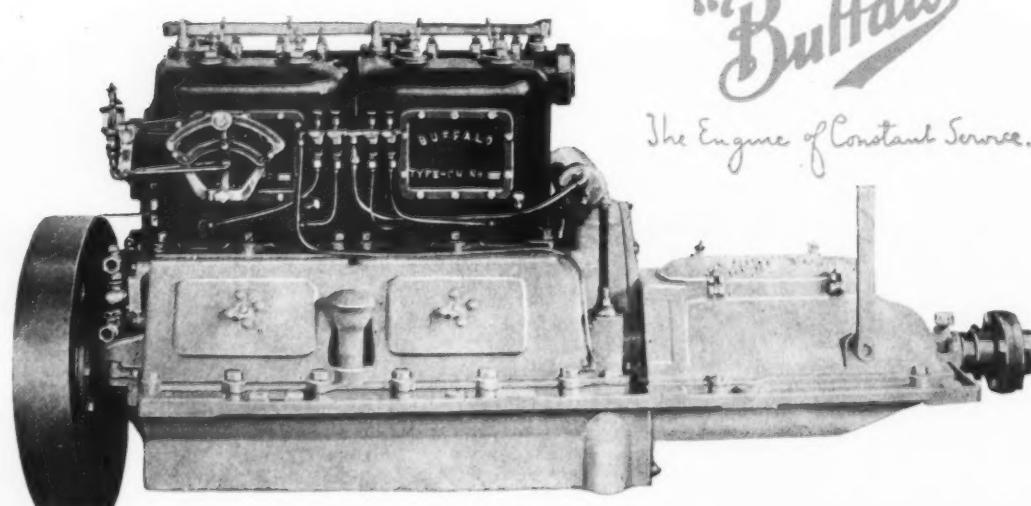
W. E. Blair says:

YOUR recent request for our commendations as to your AC plugs received and we are pleased to attest our recommendations as we have been very well pleased with the plugs and have nothing but praise for the same.

Wishing you continued success, beg to remain,

BUFFALO GASOLENE MOTOR CO.

W. E. Blair General Manager

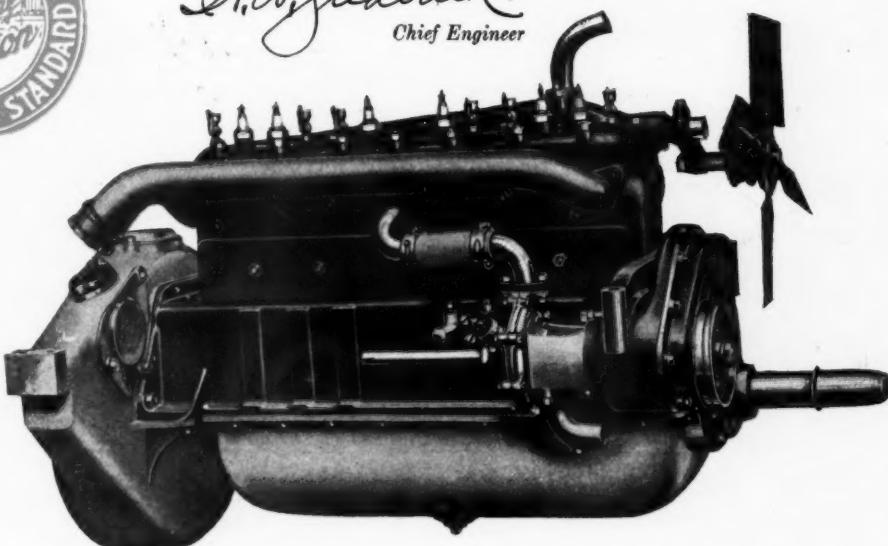


W. A. Frederick says:

OUR Engineering Department has found your AC spark plugs very efficient in our laboratory work. We believe you have an excellent product in every respect.

CONTINENTAL MOTORS CORPORATION

W. A. Frederick.
Chief Engineer



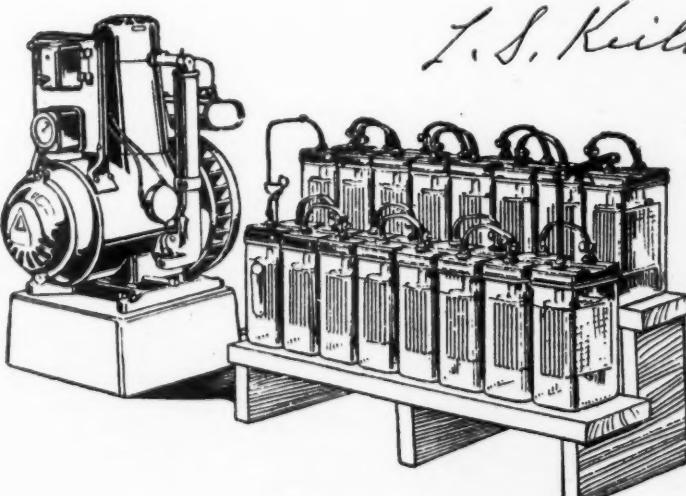
L. S. Keilholtz says:

WE thoroly tested the A C Spark Plug in our Engineering Department before adopting it for use on the Delco-Light Plant. The Delco-Light Plant is operated under full load at all times, and often on 24-hours-a-day service. Under these severe conditions we have found these spark plugs to be very satisfactory.

THE DOMESTIC ENGINEERING CO.

L. S. Keilholtz

Chief Engineer





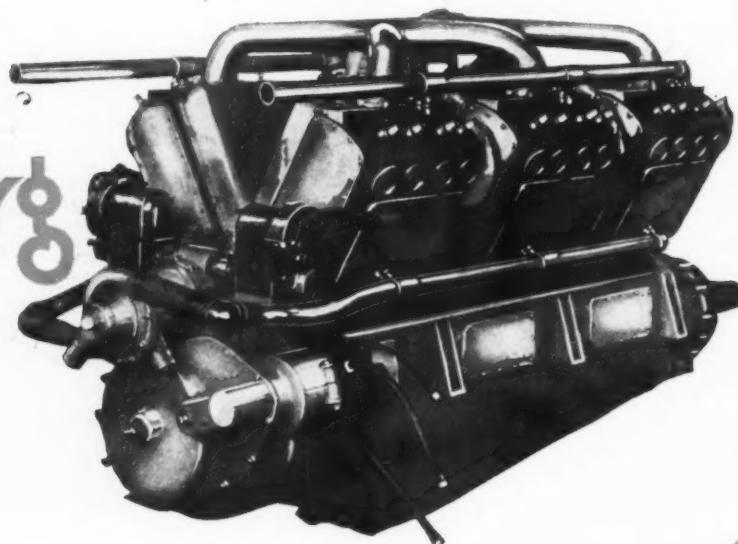
F. S. Duesenberg says:

After repeated trials of the best American and foreign spark plugs under severe conditions of automobile racing and aviation work I am convinced that you now have the most satisfactory spark plug made, and would like to have you ship us two (2) dozen aviation standard length just as soon as you can get them out.

DUESENBERG MOTOR COMPANY

F. S. Duesenberg

Duesenberg
Motors



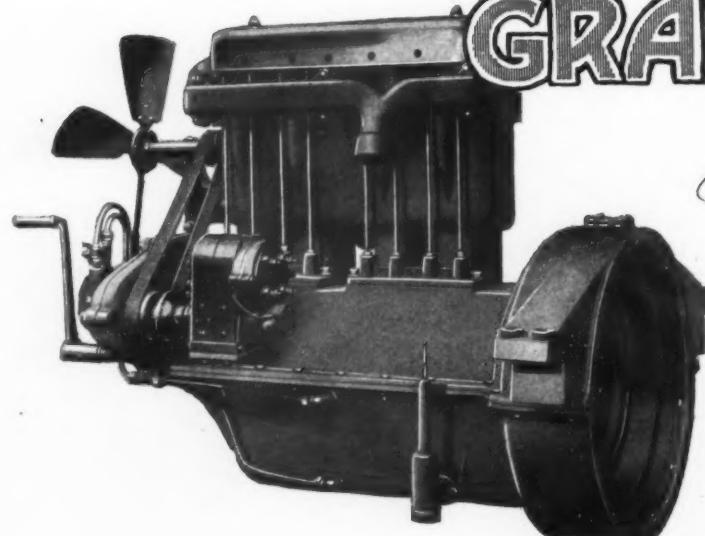
H. G. Diefendorf says:

AC Plugs have given entire satisfaction on all models of Gray motors, two and four-cycle,—Marine, Stationary, and Truck types. We have used them in special laboratory tests, in the testing room, and in service. Thousands of A. C. Plugs have been furnished with thousands of Gray motors.

GRAY MOTOR COMPANY

H. G. Diefendorf

Manager

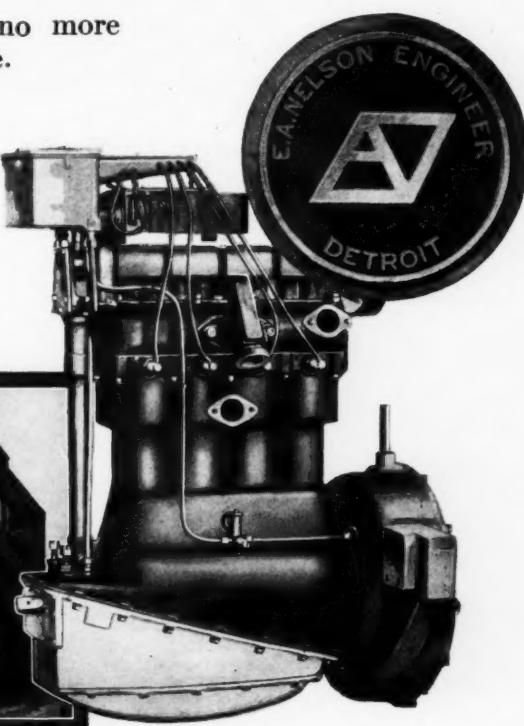


E. A. Nelson says:

THE "A. C." spark plug requires no more attention than a bolt in an engine.



Mechanical Engineer



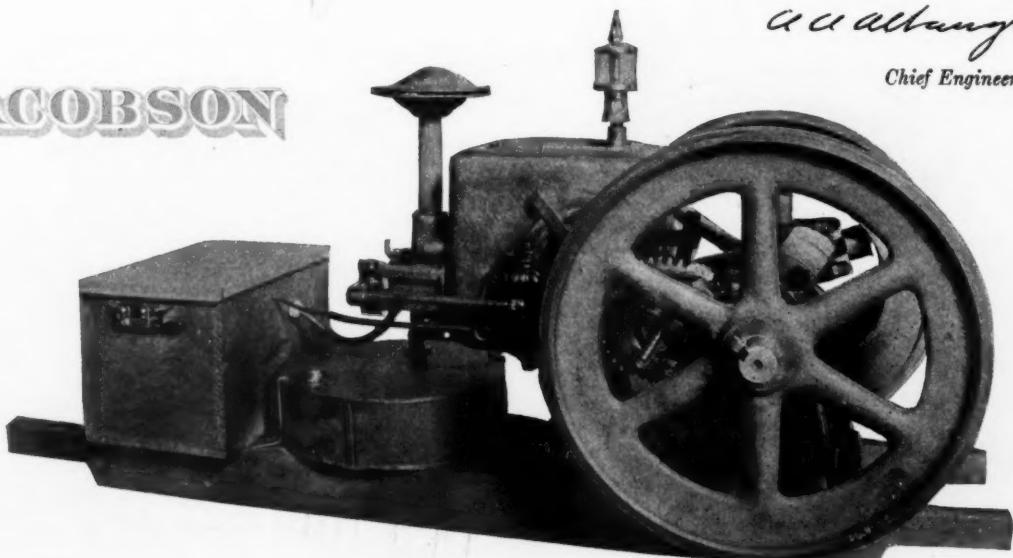
A. A. Albaugh says:

IT affords us great pleasure to state that we have been using your AC plugs for several years with the best of satisfaction.

JACOBSON MACHINE MFG. CO.



Chief Engineer


JACOBSON

A. A. Lyman says.

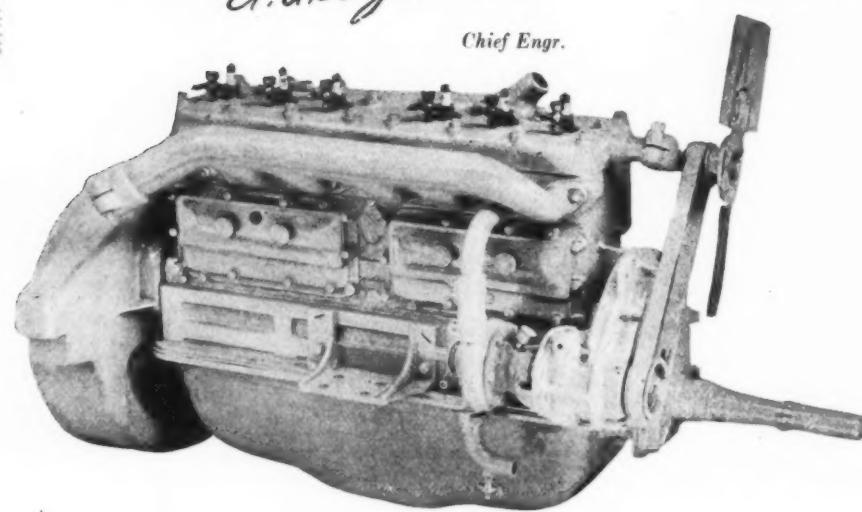
IN regard to the results we have obtained with A C spark plugs, we are pleased to state that after testing a great many different makes, we have adopted A C plugs as the most reliable, and are well pleased with the service they give us.

RUTENBER MOTOR COMPANY

A. A. Lyman.

Chief Engr.

THE
RUTENBER
MOTOR



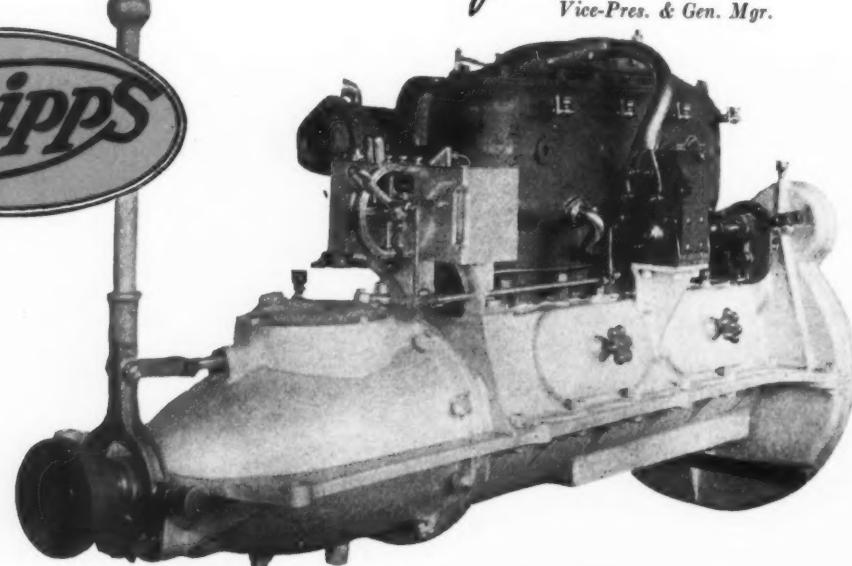
A. J. Downey says:

WE have adopted "A C" spark plugs because we honestly believe that they are the best plug that we can buy.

SCRIPPS MOTOR COMPANY

A. J. Downey.

Vice-Pres. & Gen. Mgr.

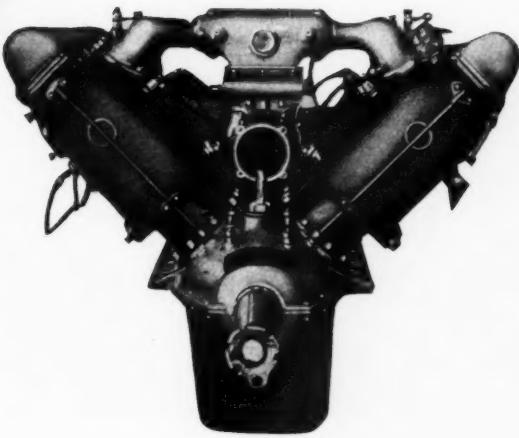


H. M. Crane says:

I AM pleased to tell you that the AC plugs have given very satisfactory service in our motors.

H. M. Crane

Vice-President



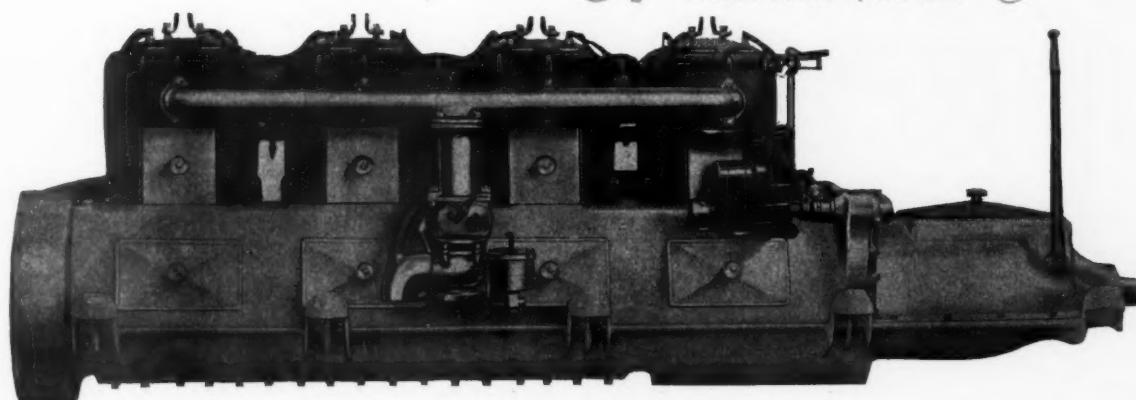
E. T. Larkin says:

WE have found the AC-Titan spark plugs to operate well in continuous operation, on our high speed, high compression marine engines.

STERLING ENGINE COMPANY

E. T. Larkin
Engineer

Sterling
THE ENGINE OF REFINEMENT
For the
finest boats that float

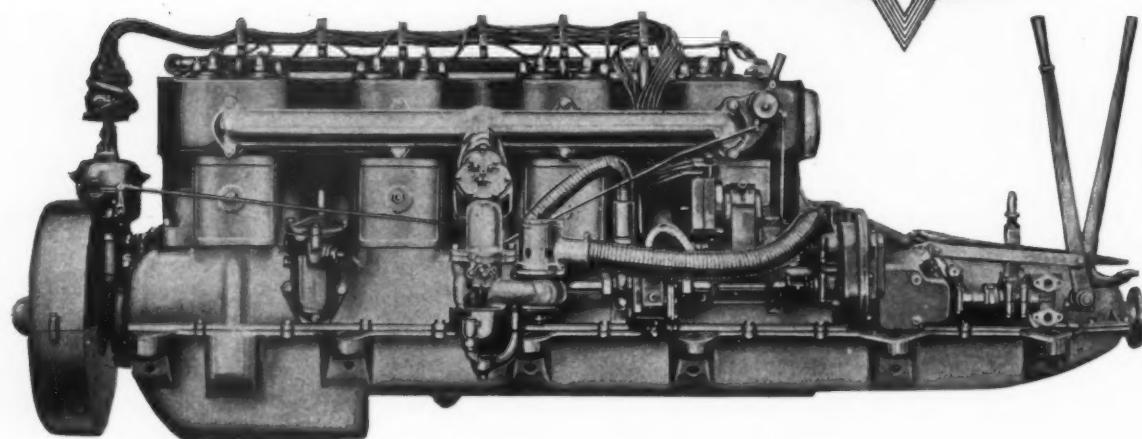




Jos. Van Blerck says:

WE have used A. C. plugs for a number of years because they progress with the motor manufacture and meet all conditions.

THE VAN BLERCK MOTOR COMPANY

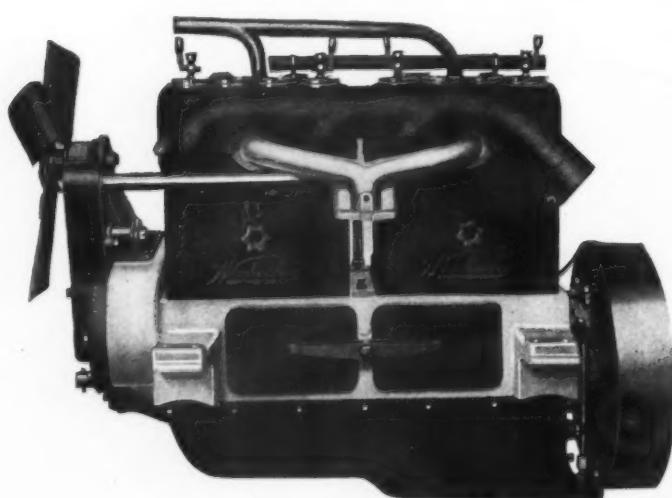


J. B. Fisher says:

IN reply to your recent inquiry regarding our experience with A-C Plugs, we are pleased to state that we have used them exclusively in our testing room for several years with very satisfactory results.

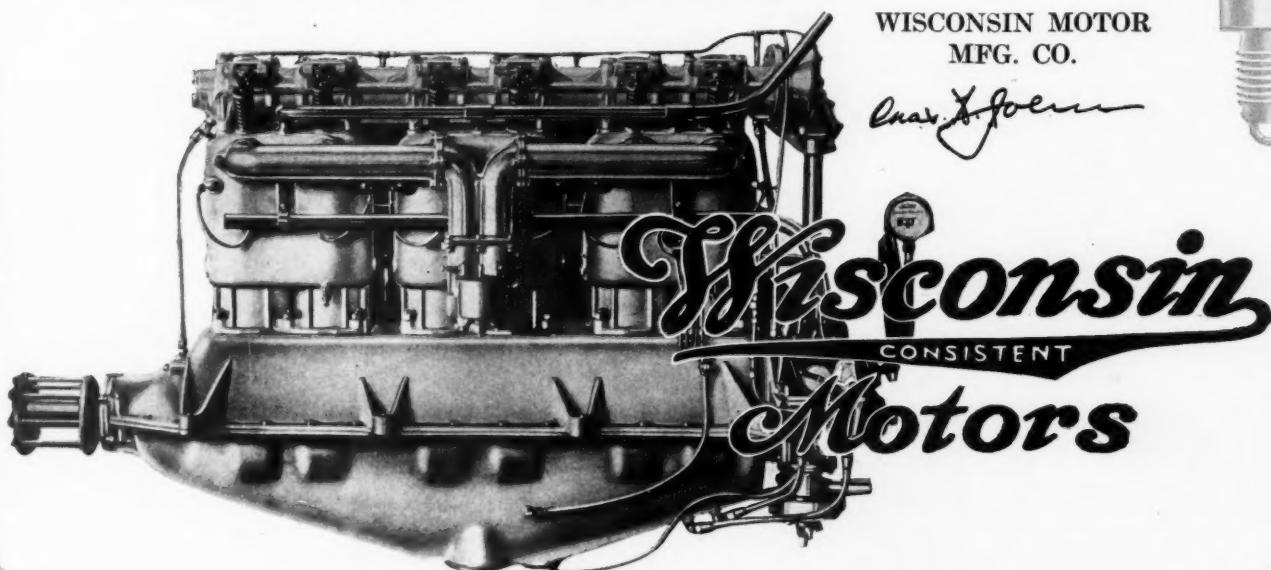
WAUKESHA MOTOR CO.

Chief Engineer



Chas. H. John says:

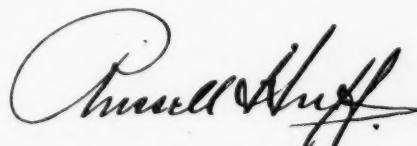
WE have been using your plugs on our motors with the greatest success and recent trials of your new plug on our aeroplane motors have proven that we no longer have to depend on imported plugs to get satisfactory results on high compression motors. We wish to congratulate you and believe you have rendered our country most valuable services.



Russell Huff says:

MY experience with A C spark plugs extends over a period of several years, during which time I have noted a continuous evolution of improvements which has resulted in the production to-day of a modern spark plug of the very highest order.

It has been my privilege to watch the results of several hundred thousand A C plugs used in actual production during the last eighteen months. The excellent performance of these is a forceful expression of the quality and perfection to be found in A C plugs.

A large, flowing cursive signature of "Russell Huff".

Chief Engineer of
Dodge Brothers



A. P. Brush says:—

MY personal experience with A. C. Spark Plugs, down to date, covers a period of over nine years, and through our clients includes their use in very large quantities, and in widely varying types of motors.

In design, construction and service they have always been abreast and usually ahead of their contemporaries.

BRUSH ENGINEERING ASSOCIATION

A. P. Brush.



A MESSAGE TO DEALERS

By ALBERT CHAMPION, President Champion Ignition Co.

HAVE you ever stopped to think that it is a common trait to exercise more care in most personal transactions than in the selection of many articles that mean so much to your business? If you required an operation you would only call in the most successful and reputed surgeon. You make sure that a bank is sound and well managed before entrusting it with your money. You take out insurance only in companies that are stable and reliable. You ask for satisfactory references before engaging a man for a responsible position.

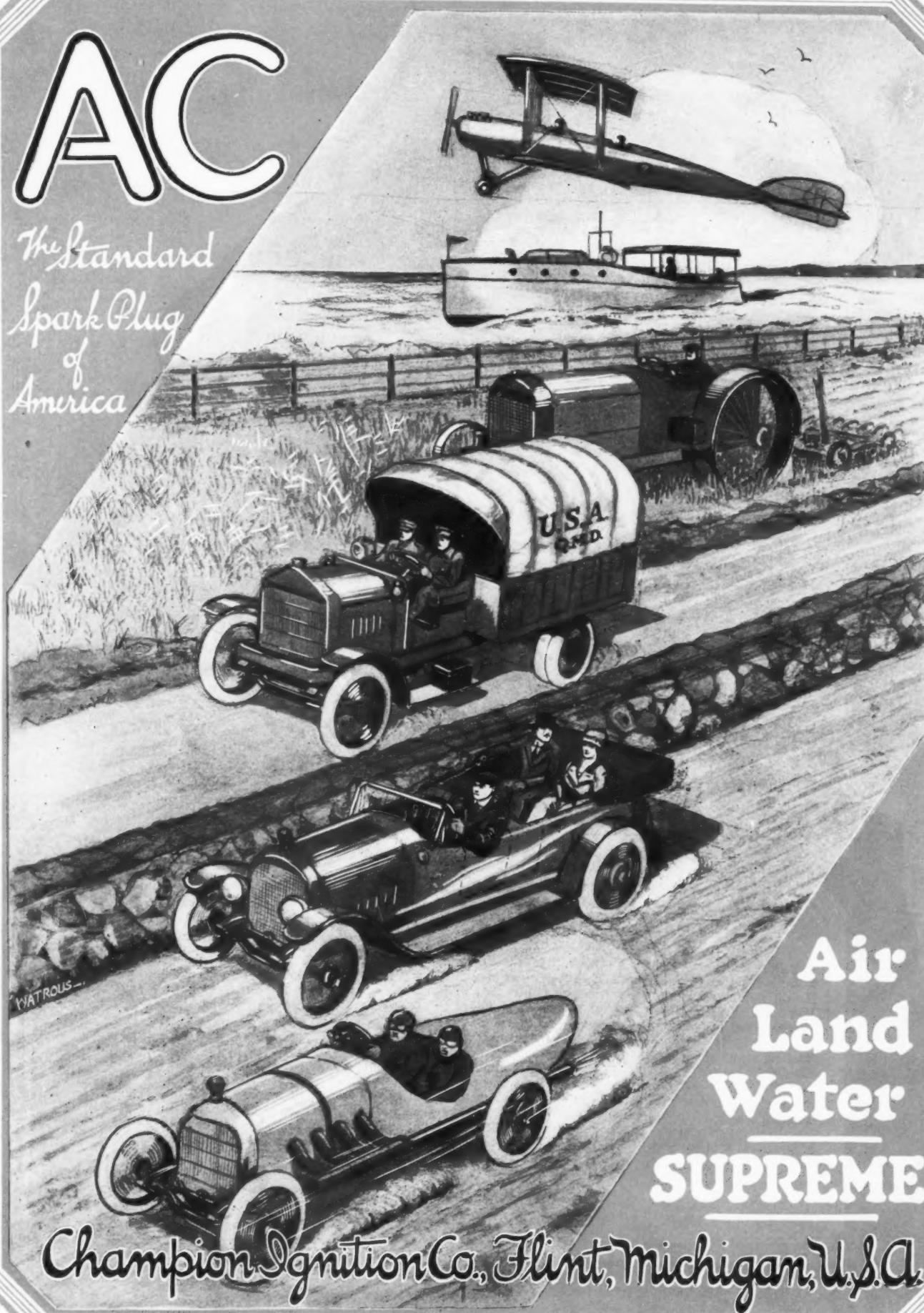
And yet many dealers will invest their money in Spark Plugs on the strength of extravagant claims not backed by any substantial proof of quality or past record.

MR. DEALER—We do not make extravagant claims, we do not have to, we give you the highest references. Bordering this page, you will see the names of Motor Car and Truck makers who use AC Plugs for regular equipment. They are all quality firms and their endorsement constitutes our strongest reference. Invest your money safely; stock the plug your customers need; the plug which gives you more sales—more profits—no dead stock—and helps you build your business on a sound basis.

Albert Champion

AC

*The Standard
Spark Plug
of
America*



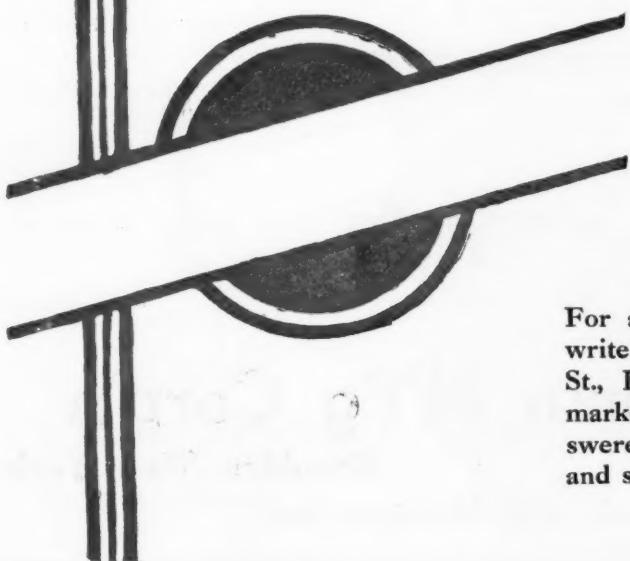
Air
Land
Water
SUPREME

Champion Ignition Co., Flint, Michigan, U.S.A.

In the East—

the New England and North Atlantic States—there will be open for the first time to big distributors, several of the most fertile selling fields for these well-known cars and one-ton trucks. This territory will be allotted with discrimination and care. Applicants must qualify.

See announcement next week



For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.



Lohmannized
(Rust-Proof)

Bumpers

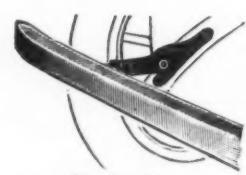
Protection for Front and Rear—Motor Cars and Motor Delivery Wagons



Double-Spring Bumper



Fitsall

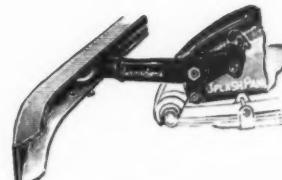


Packard

EverGood Bumpers are Designed as skillfully as the Car—Constructed as sturdily as the Chassis—Finished as durably as the Body.

EverGood Bumpers are the first automobile accessory to be made permanently rust-proof by a special process—Lohmannizing.

Lohmannizing fills the pores and coats the surface of the steel with a non-corrodible metal alloy and prevents rust from forming. EverGood Lohmannized Bumpers will retain their bright finish in any climate—under all atmospheric conditions. Lohmannizing can be had only on EverGood Bumpers. Write for catalog



Splash-Pan



Ford

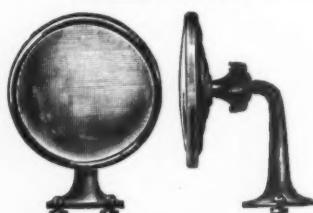


(Rust-Proof)

Mirrors



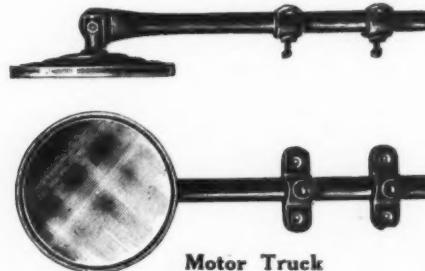
Windshield Mirror



Fender Mirror

EverGood Mirrors make the driver as complete a master of the road in the rear as the eyes do of the road ahead. A new standard of quality has been established by us in the Mirror art. We have designed stamping dies that render every operation a revelation in clean workmanship and finish. The clamp (patented) fits round, oval, or square windshield frames.

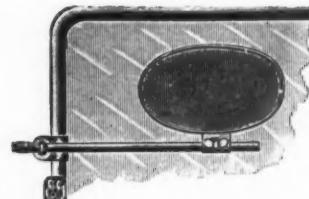
Catalog on request.



Motor Truck



Limousine Mirror



Glare Dimmer

Emil Grossman M'f'g Corp'n

Bush Terminal Bldg. No. 20,

Brooklyn (New York City)

Chicago Branch, 1253 Michigan Ave.

Vitristone

Reg. U. S. Pat. Off.

The First Real Improvement Since Spark Plugs Have Been Made

DO you realize that porcelain plugs of to-day are made of practically the same material as the first spark plug produced in Europe about seventeen years ago?

Each succeeding year has seen a higher development of the automobile motor, but the spark plug has been left behind in the march of engineering progress. That is one reason why you hear so many complaints. Last season more fast racing cars were defeated due to the inefficiency of spark plugs than all other causes combined.

What caused spark plugs to break down? The brittleness of the porcelain. Modern motors are designed to operate at the maximum allowable degree of heat, and the plug is located in the hottest part of the explosion chamber. The heat of the explosion and the intake of the cool gases alternate with lightning rapidity. In a 3400 R.P.M. motor the plug is heated to explosive temperature 1700 times, and cooled by the intake gases 1700 times—per minute. Porcelain cannot withstand such severe strains for any considerable length of time.

The situation was almost desperate. The research and experimental departments had been working for almost two years to find a solution.

At last we solved the problem. The result was not a substitute, but the successor to porcelain—VITRISTONE.

VITRISTONE is what the name suggests—artificial vitrified stone. It has the high insulating properties of glass and the hardness of stone. It is to porcelain what a stone crock is to a china cup.

**Emil Grossman
M'f'g Corp'n**

Bush Terminal Bldg. No. 20
Brooklyn (New York City)
Chicago Branch, 1253 Michigan Ave.



Everyone is familiar with the fact that a porcelain cup may be cracked when the tea is poured in too hot, while a stoneware dish may be placed in a fiery oven without cracking.

VITRISTONE has more than merely made good—it has made porcelain plugs obsolete—in the same sense that six, eight and twelve cylinder cars are the higher development of the "one lunger." All other spark plug manufacturers are seeking something better than porcelain but VITRISTONE can be had only in Red Head Plugs because it is made in our own potteries in Trenton, N. J.

Look for Vitristone on the Insulator and the Red-Enamelled Bushing.

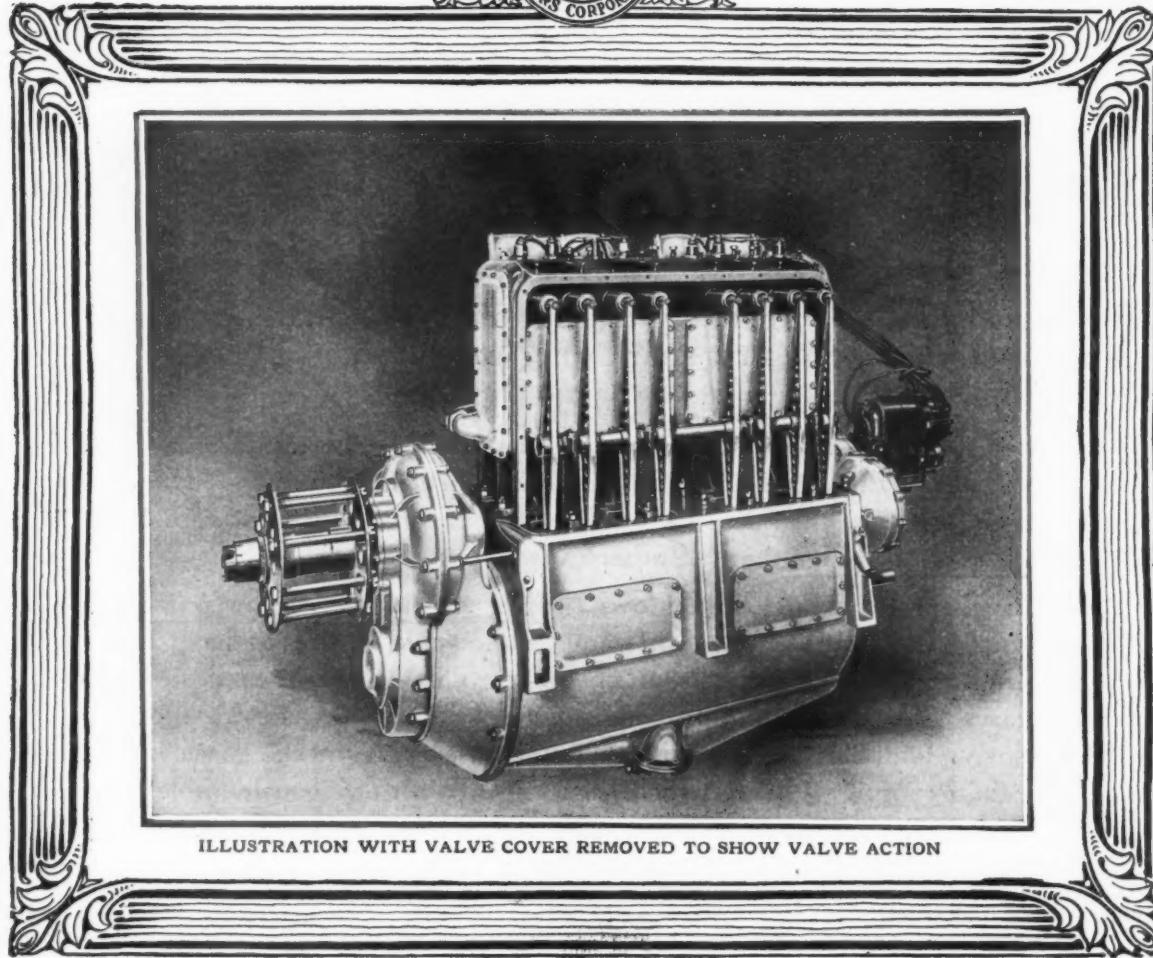


ILLUSTRATION WITH VALVE COVER REMOVED TO SHOW VALVE ACTION

Brief Specifications

Sixteen Valve Duesenberg Aeroplane Motor

FOUR cylinder $4\frac{3}{4}''$ x $7''$, 125 H.P. at 2100 R.P.M. of the crankshaft and 1210 R.P.M. of the propeller. Motors are sold on above rating; actual power tests prove this motor capable of developing 140 H. P. at 2100 R. P. M. of the motor. The exact weight with magneto, carburetor, gear reduction and propeller hub, as illustrated, 509 lbs. Without gear reduction, 436 lbs. Net price of this four cylinder motor with regular engine equipment but not with reduction gear, \$3050.00; net price with reduction gear, \$3500.00.

Cylinders are semi-steel with aluminum plates enclosing water jackets. Pistons specially ribbed and made of Magnalite aluminum compound. Piston rings of special Duesenberg design, being three piece rings. Valves are Tungsten Steel, $1\frac{15}{16}''$ inlets and $2''$ exhausts, two of each to each cylinder. Arranged horizontally in the head, allowing very thorough water-jacketing. Inlet valves in cages. Exhaust valves,

seating directly in the cylinder head, are removable through the inlet valve holes. Valve stems lubricated by splash in the valve action covers. Valve rocker arms forged with cap screw and nut at upper end to adjust clearance. Entirely enclosed by aluminum housing as is entire valve mechanism. Connecting rods are tubular, chrome nickel steel, light and strong. Crankshaft is one piece forging, hollow bored, $2\frac{1}{2}''$ diameter at main bearings. Connecting rod bearings $2\frac{1}{4}''$ diameter, $3''$ long. Front main bearing $3\frac{1}{2}''$ long; intermediate main bearing $3\frac{1}{2}''$ long, rear main bearing $4''$ long. Crankcase of aluminum, barrel type, oil pan on bottom removable. Hand hole plates on both sides. Strongly webbed.

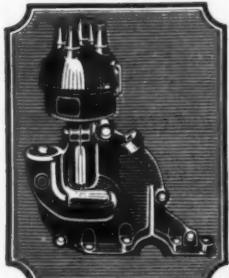
Full and complete information will be cheerfully supplied and every courtesy extended to you in carrying out your investigations. Our factory facilities are such that satisfactory deliveries can be made.

Duesenberg Motors Corporation

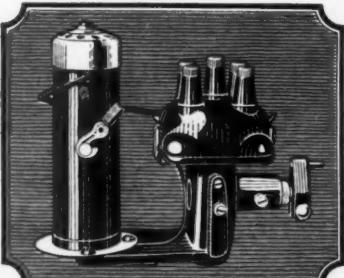
120 Broadway, New York City

ATWATER KENT

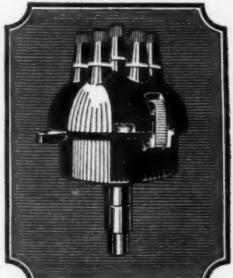
SCIENTIFIC IGNITION



Type K-2 Outfit for Ford
cars with Automatic
Advance Feature



Type CC Magneto Replacement Outfit
Specially adapted to Maxwell, Overland and
other 4-cylinder cars



Type K-3 System
for Standard
Equipment

THE mechanical construction and operating efficiency of Atwater Kent Scientific Ignition is the result of a strict observance of correct engineering principles. Systems that have been in use ten years and run considerably over 100,000 miles show little or no mechanical wear or loss of operating efficiency.

You, as a dealer, can sell Atwater Kent Scientific Ignition with a perfect confidence in its unfailing performance. Be known as the authorized Atwater Kent dealer in your locality.

WRITE US FOR OUR DEALER PROPOSITION

You know you will never have to offer excuses for the performance of Atwater Kent Scientific Ignition. If you have not sold Atwater Kent Scientific Ignition write in for our dealers' proposition.

ATWATER KENT MFG. WORKS
Philadelphia

ATWATER KENT MANUFACTURING WORKS, 4938 STENTON AVENUE, PHILADELPHIA, PA.

Prest-O-Lite

Storage Battery

MOTORISTS everywhere have unhesitatingly expressed their confidence in the ability of The Prest-O-Lite Co., Inc., to produce a storage battery not only equal to but superior to existing types. That confidence has been justified. From the standpoint of efficiency, longer life and faithful service, the Prest-O-Lite Battery has a character all its own.

1—Plate Construction

Extreme porosity and large exposed area of the "active" material in the plates insures consistent chemical action during charge and discharge, enabling the battery to give off a large volume of current, with sustained high voltage, less internal heat than any other battery, and with freedom from injurious chemical action—retaining its charge during comparatively long periods of rest. Chemically pure pasted material is locked in by special grid design, insuring permanent rigidity and strength.

2—Separators

Made from carefully selected wood of extreme porosity, insuring perfect insulation with maximum circula-

tion of electrolyte. Specially treated to remove all matter which might prove injurious to the electro-chemical action.

3—Electrolyte Level

The electrolyte should always be at least $\frac{1}{4}$ inch above the tops of the separators. This allows for evaporation during operation. The height of the electrolyte may be measured with a clean glass tube. Insert the tube through the vent until it rests on the top of the separators, cover the end with a finger and withdraw. Electrolyte will remain in tube, indicating the depth of solution over separators. Specific gravity of electrolyte should be between 1.285 and 1.300 in a full charged battery.

4—Bridges for Plate Support

Positive and negative elements rest on bridges which reinforce bottom sections of hard rubber jars and provide ample space to accommodate accumulation of sediment (the result of normal operation).

5—Plate Connectors

Substantial, rugged design insures maximum electrical conductivity and great strength for keeping positive and negative elements in perfect alignment.

6—Hard Rubber Jars

Made of special composition hard rubber. Each jar undergoes an electrical test of 24,000 volts and a rigid mechanical test. Jar construction insures long life and the ability to

Not only a better battery, but



withstand the strains of strenuous service.

7—Jar Covers

Designed to allow the greatest possible expansion space and to overcome slopping of acid when the car is in motion. Undergo rigid electrical and mechanical tests.

8—Sealing Compound

Special composition of high elasticity and acid resisting qualities, insuring perfect adhesion to jars and covers, with perfect freedom from cracking during cold weather or softening in summer.

9—Filler Openings

Vents are large enough to permit easy inspection and filling with distilled water. Caps are easily removed.

10—Terminals and Cell Connectors

Sufficiently large to carry the highest rates without over-heating, resulting in high terminal voltage on discharge. Design insures freedom from acid creepage around posts. Terminals have ample current carrying capacity and provide simple connections to car wiring.

11—Hardwood Box

Made from selected hard wood, with dove-tailed corners and hard maple dowel-pin construction to prevent spreading of joints and corners. Painted with a special preparation which resists the action of acid. Built to withstand the roughest service.

12—Handles

Stamped and pressed from heavy sheet metal, heavily lead plated and enameled. Special provision for securing to battery hold-downs on car.

You can feel safe in purchasing the Prest-O-Lite Battery, which is the product of a company with an enviable reputation for uniform quality and satisfactory service—one that has enjoyed the confidence of the motoring public over a long period of years.

No matter what battery you now use, the world-famous Prest-O-Lite Service System is at your disposal whenever your battery needs attention.

When your present battery wears out, remember there is a Prest-O-Lite Battery of the correct size for your car.

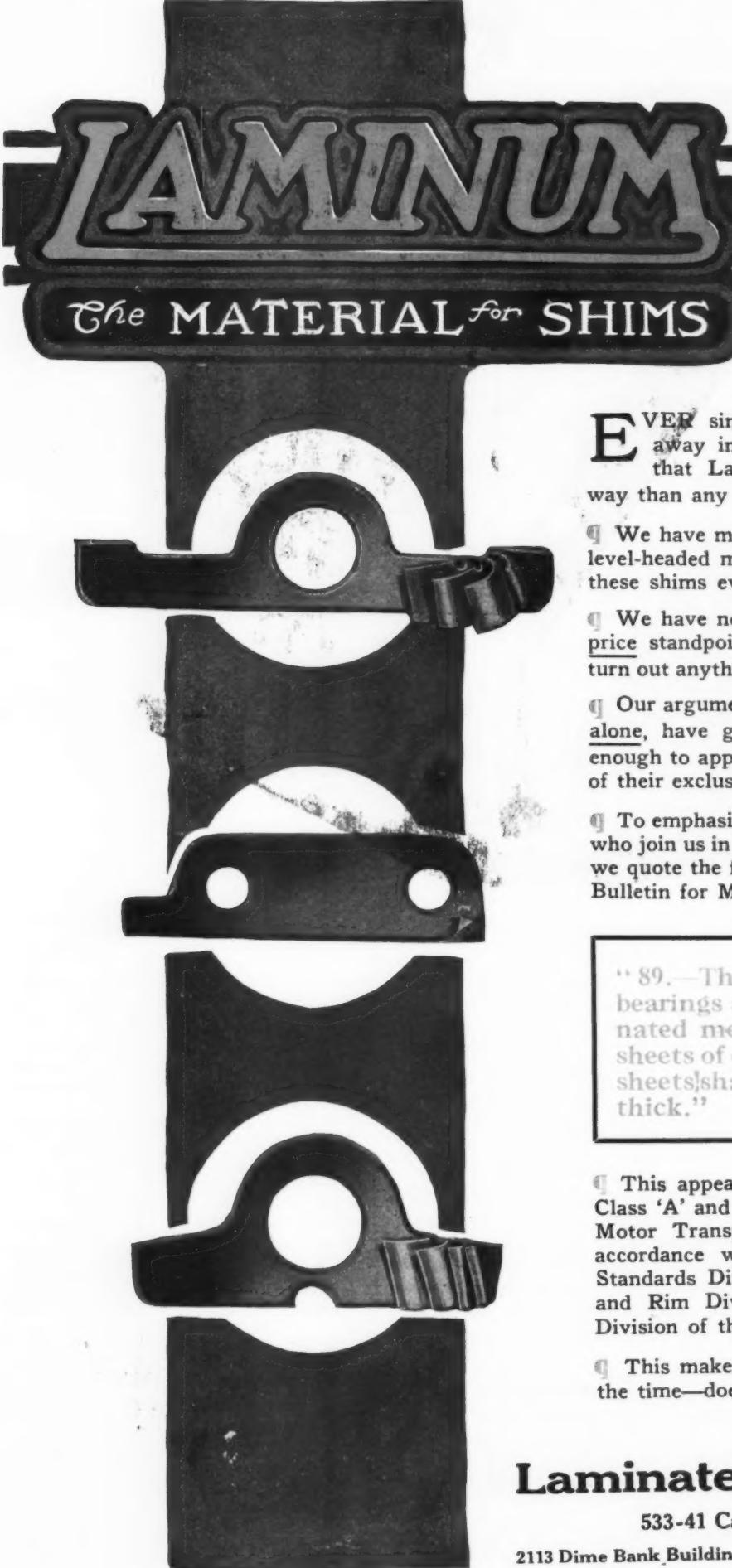
DIRECT FACTORY BRANCHES

Atlanta	Des Moines	Montreal
Baltimore	Detroit	New York
Boston	Indianapolis	Omaha
Buffalo	Jacksonville	Philadelphia
Chicago	Kansas City	Pittsburgh
Cincinnati	Los Angeles	San Francisco
Cleveland	Memphis	Seattle
Dallas	Merrittton	Syracuse
Davenport	Milwaukee	St. Louis
Denver	Minneapolis	St. Paul
	San Antonio	Winnipeg

The Prest-O-Lite Co., Inc.

U.S. Main Office and Factory:
900 Speedway, Indianapolis, Ind.
Canadian General Office and Factory:
Toronto, Ont.

backed by Prest-O-Lite Service



EVER since 1911 we have been hammering away in an attempt to drive home the fact that Laminated Shims are better in every way than any other kind.

¶ We have made many converts among far-seeing, level-headed men, who could see the advantages of these shims even if their price was a little higher.

¶ We have never talked about these shims from a price standpoint. If we had, our plant could not turn out anything like enough to fill the demand.

¶ Our arguments, based on quality and time saving alone, have gotten home to those who are wise enough to appreciate these shims and the real value of their exclusive features.

¶ To emphasize the distinguished character of those who join us in our high opinion of Laminated Shims, we quote the following from page 171 of the S.A.E. Bulletin for May:

“89.—The main and connecting rod bearings shall be provided with laminated metallic shims, made up of sheets of equal thickness. The shim sheets shall be not more than 0.002 in. thick.”

¶ This appears under “Standard Specifications for Class ‘A’ and Class ‘B’ Motor Trucks, prepared by Motor Transport Board of War Department in accordance with recommendations of the Truck Standards Division, the Springs Division, the Tire and Rim Division and the Electrical Equipment Division of the Society of Automotive Engineers.”

¶ This makes it look as though we were right all the time—doesn’t it?

Laminated Shim Company

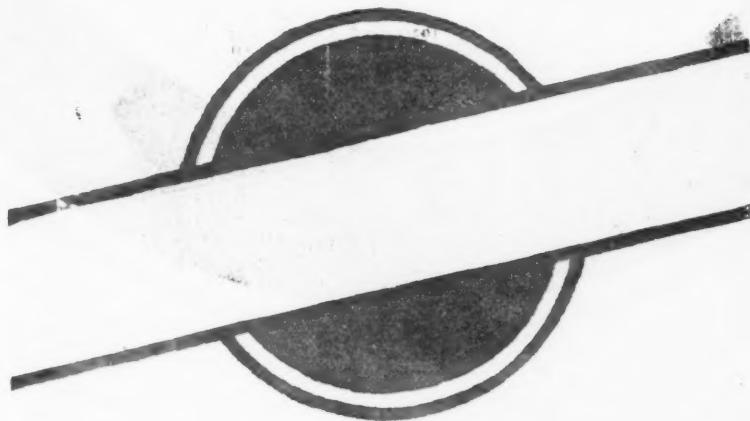
533-41 Canal Street, New York, N. Y.

2113 Dime Bank Building - - - - - Detroit, Mich.

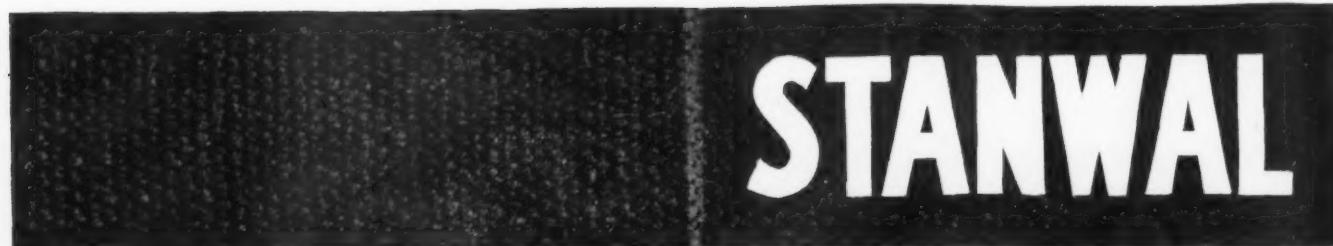
Please mention **The Automobile** when writing to Advertisers

This manufacturer
has always recognized
the important status of
its dealers. Meeting the
dealers' increased cost of
doing business by increasing
its dealer discount, was no
more than appreciation of the
fact that dealer loyalty and
goodwill is a company asset.

See announcement next week



For advance information wire or
write MOTOR AGE, 95 West Fort
St., Detroit, Michigan. Inquiries
marked "Confidential" will be an-
swered direct by MOTOR AGE
and so treated.



Please mention The Automobile when writing to Advertisers



ANNOUNCING STANWAL BRAKE LINING

Stanwal is the result of years of experience in developing brake and clutch linings. It marks a distinct advancement in manufacture. It is an engineering achievement.

From our laboratories came the far-famed Multibestos Brake Lining and Clutch Facing. And the performance of our products as standard equipment on the Packard, Pierce Arrow, Locomobile and other leading cars is proof of recognized quality.

In step with the progress of automobile making, the products of the Standard Woven Fabric Co. have advanced to meet each new and exacting demand.

The latest advancement is Stanwal—a special brake lining material.

Stanwal is the crowning accomplishment of a determination to produce the best possible brake and clutch lining. Tests have proved it superior to any other friction material. Stanwal even surpasses Multibestos. It sets a new standard of quality.

Before introducing Stanwal we subjected it to the most severe and exhaustive tests, both in our own laboratories and in road service. Still further tests have been made at the Massachusetts Institute of Technology and in the testing departments of a number of automobile manufacturers.

The yarn from which it is made is carded and spun in our own factory under the direction of our own experts. Every facility for the manufacture of quality goods has been provided in this factory—the largest and most complete one devoted to the manufacture of Brake and Clutch Linings.

The results of all tests show Stanwal to have a uniform coefficient of friction of .40 as against .37 in the average brake lining material.

In competitive tests to determine wear resistance, its superiority was equally apparent. Under one set of conditions it showed a $17 \frac{4}{10}\%$ wear, where its nearest competitor showed $33 \frac{4}{10}\%$.

Stanwal is impervious to oil, grease, gasoline, water or any foreign substance. It does not scratch the brake drums. It is noiseless under severe pressure. It operates smoothly and firmly and controls any car with power and precision.

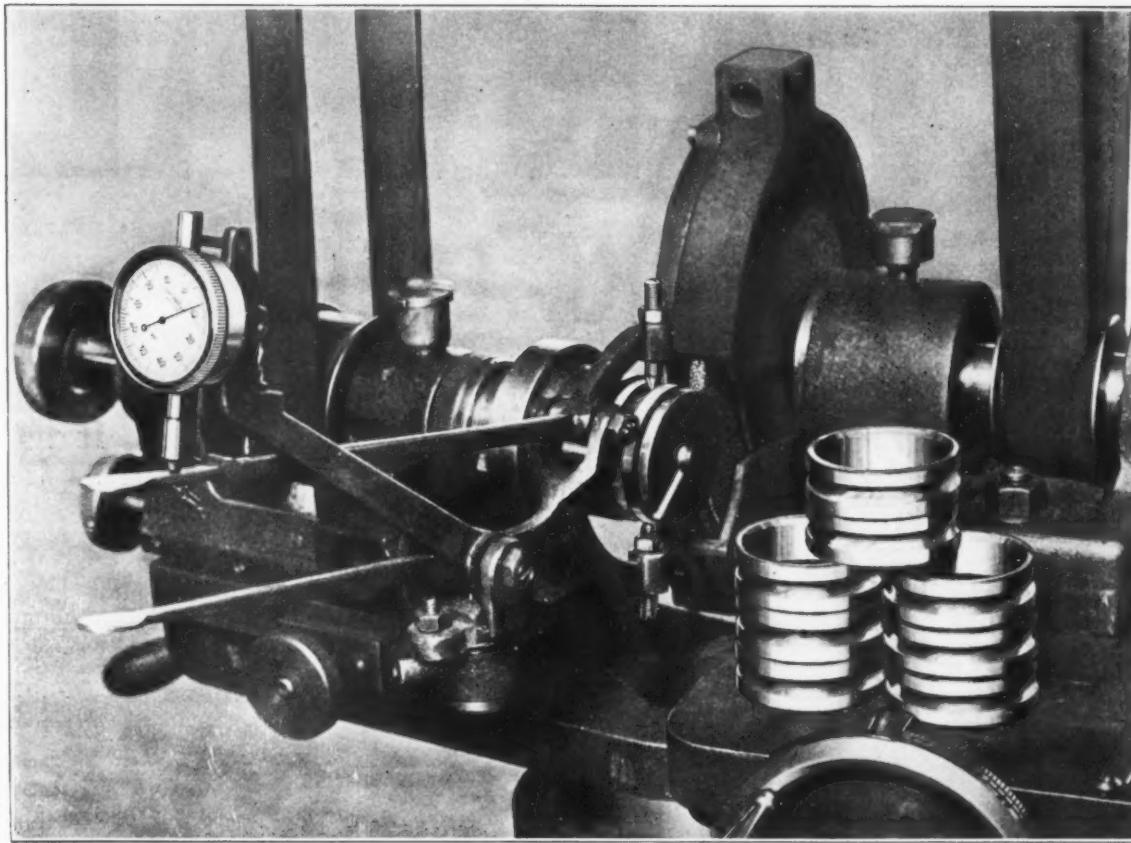
The primary base of Stanwal is brass wire covered and protected by a special fabric, specially treated, proof against frictional heat.

The treatment used to procure the frictional quality of Stanwal is such that the heat resisting quality increases as the frictional pressure is applied. In other words, Stanwal improves with use.

Standard Woven Fabric Co., Walpole, Mass.

TRADE MARK REG.

Positive Running Truth

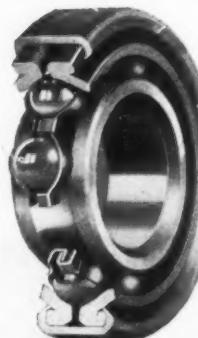


Positive running truth must be obtained to ensure concentric running of the completed bearing. As the Schatz "Universal" Cones are ground a dial indicating gauge registers to points of extreme fineness the diameter of the ball race and the running truth of the grinding spindle. At the right are finished cones. Note the depth of the ball race.

The Schatz "Universal" Annular Ball Bearing

Sustains successfully a thrust load in either direction not less than 50% of its rated radial capacity—without adjustment or impairment of annular efficiency

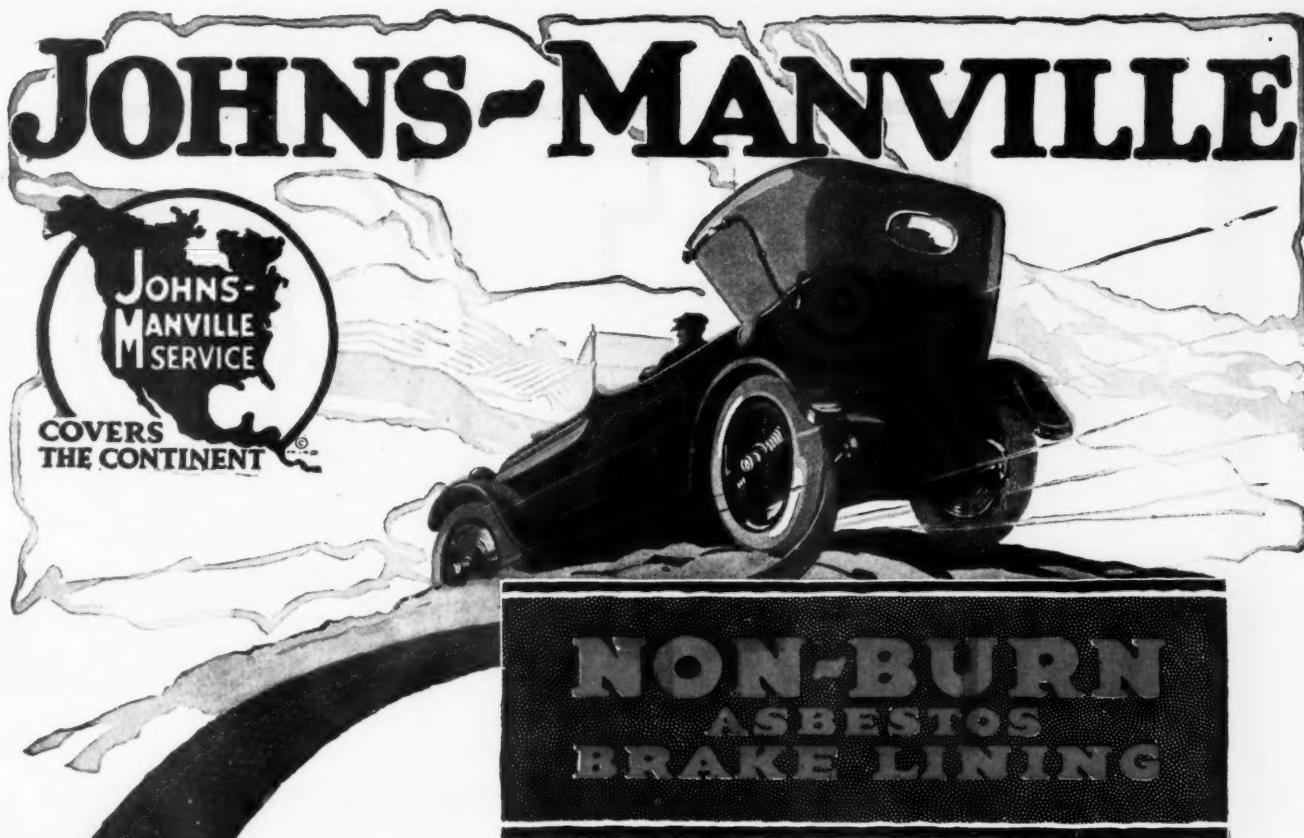
Automatic dial indicators rigidly inspect and gauge to extreme accuracy each running part of the Schatz Universal Annular Ball Bearing during the process of manufacture. The completed bearing is internationally standardized — interchangeable — without adjustment—with all other standardized bearings of the same size and type.



The balls have three points of contact: One on the inner race and two in the outer, located on a given angle to the centre of the bearing. The spacer is rivetless and self-locking, and, therefore, of sufficient flexibility to accommodate itself to the change in the axis of rotation when a thrust load is applied.

Catalog and Data Sheets for Engineers

THE FEDERAL BEARINGS CO., Inc.
26 WILLIAM STREET POUGHKEEPSIE, N. Y.



IN brake lining it's the quality of the asbestos fibre that counts—and high-grade fibre grows scarcer every day.

But that's another argument for Non-Burn, for it's made at Asbestos Headquarters—Johns-Manville. We mine our own Asbestos, and of the thousands of tons produced annually, our experts choose for Non-Burn only the choicest fibre, strong and uniform.

Non-Burn is sold under a trade policy which is on a par with the lining. Distributed to the trade through regular jobber-dealer channels only, under generous discounts, uniform and rigidly maintained regardless of quantity—so it's not necessary to tie up capital in large stocks to secure fair profits. Details of this liberal sales policy will be furnished promptly on request.

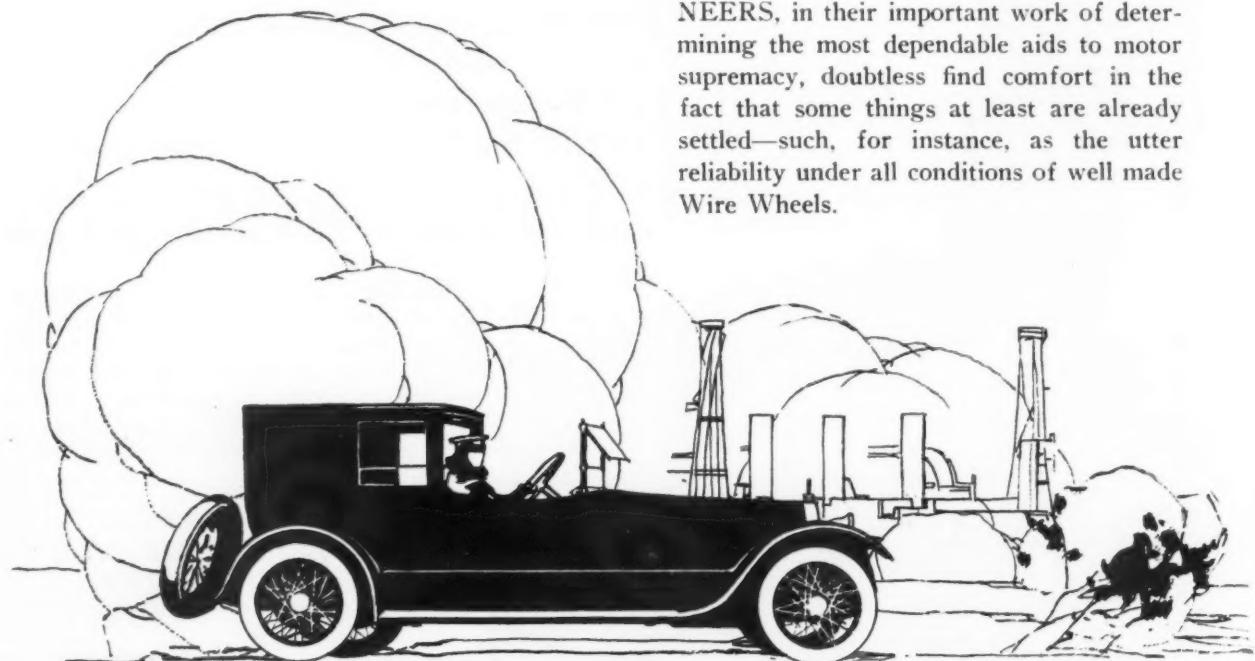
H. W. JOHNS-MANVILLE CO.
NEW YORK CITY
10 Factories—Branches in 55 Large Cities

**When you think of Asbestos
you think of Johns-Manville**



TO
QUICK
WIRES

AMERICAN AUTOMOTIVE ENGINEERS, in their important work of determining the most dependable aids to motor supremacy, doubtless find comfort in the fact that some things at least are already settled—such, for instance, as the utter reliability under all conditions of well made Wire Wheels.



The past year has seen the popularity of wire wheels more than redoubled.

For good looks—for the proper setting off of distinctive custom-made cars—they stand unrivaled.

For strength, durability and ease of manipulation, they have won first place in the very fields where those characteristics are most in demand.

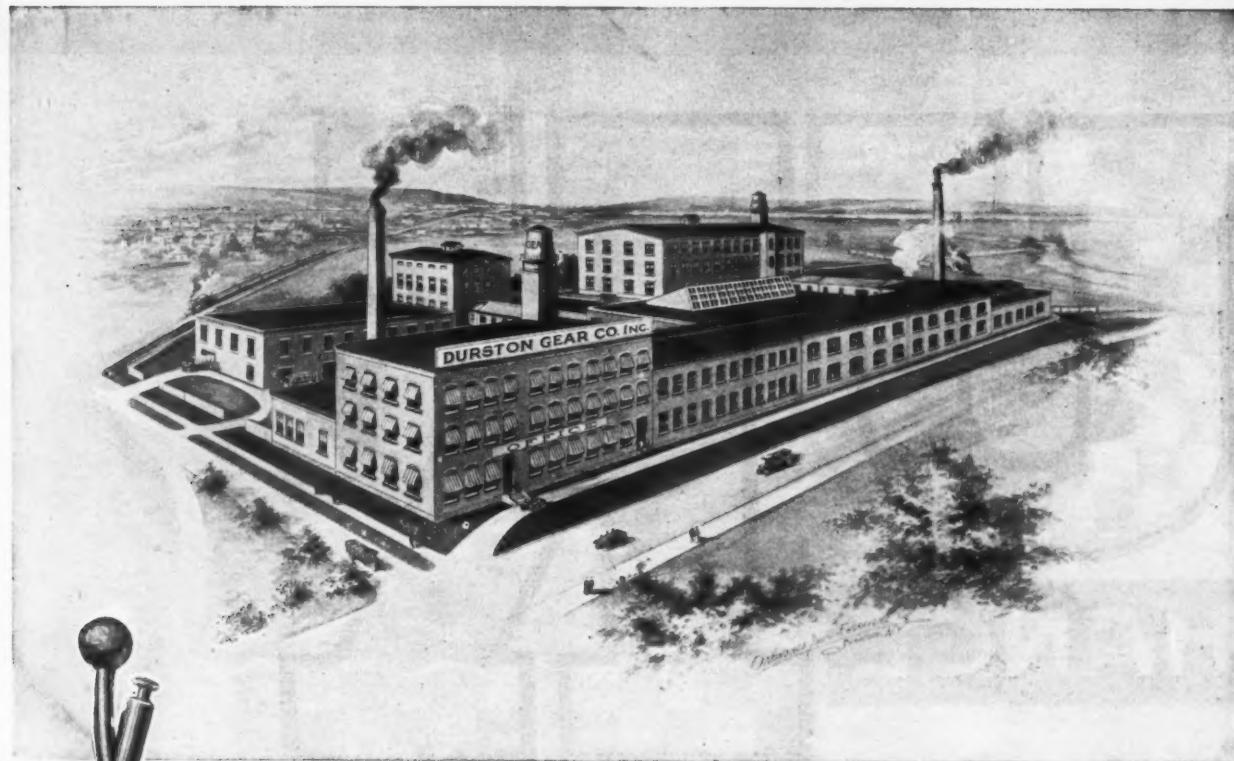
Houk Wire Wheels have won distinct victories on Armored Cars, and in the Racing Field, as well as on the glistening show cars that made the past season so far excel its forerunners in brilliancy and diversity of output.

HOUK MANUFACTURING CO., Buffalo, New York

BRANCH OFFICES AND SERVICE STATIONS

New York, 1792 Broadway; Chicago, 2337 Michigan Avenue, South; Philadelphia, 328 North Broad Street; Detroit, 786 Woodward Avenue; Boston, 1092 Commonwealth Avenue; San Francisco, 1243 Van Ness Avenue; Pittsburgh, 600 Grant Boulevard; St. Louis, 3414 Lindell Avenue; Dallas,

2029 Commerce Street; Minneapolis, 918 Marquette Avenue; Richmond, 1807 West Broad Street; Los Angeles, 1101 S. Hill Street; Nashville; Buffalo 1064 Main Street; Sioux Falls, 315 West 9th Street; Winnipeg, King and Bannatyne.



The plant where Durston Transmissions are made

DURSTON TRANSMISSIONS

"Gears of Lasting Fame"



One of Our Models

Best quality materials—careful machining—rigid inspection has given them strength and durability. The noted performance of Durston Transmissions is due to the ability of our plant—specialized engineering force—and skilled workmen.

We are now prepared to submit designs on truck transmissions to meet all conditions.

Write for data; also state requirements. Deliveries prompt

DURSTON GEAR CO., Inc.

18 MALTBIE ST.

SYRACUSE, N. Y.



*Men
Methods
Materials*

*The Forces Behind the Highest-Priced
Truck Axles Built in America*

SHELDON
AXLES

The Excellence of a Sheldon Axle is Established In a Multitude of Different Ways Before it Finally Reaches the Ultimate User

SHELDON MEANS QUALITY, FROM FIRST TO LAST

Beginning with the raw material, each lot received is triple tested for quality. It must contain the right elements in exactly the right proportions necessary for hardness, toughness, strength, shock resistance and fatigue resistance.

Should tests reveal even a slight weakness in any one of these elements, the material is refused, no matter whether it is 10 lbs. or 10 car loads.

Thus it is that the excellence of the raw material used in building Sheldon axles is established before it is even accepted.

And so on, through a thousand different necessary operations, every part of a Sheldon axle and every bit of work done must measure up to the high standards and accurate limits set by Sheldon, standards that are never lowered, regardless of circumstances or conditions.

In the microscopical laboratory, where molecular structure is determined and where inherent imperfections and unequal distribution of carbide constituents are quickly detected

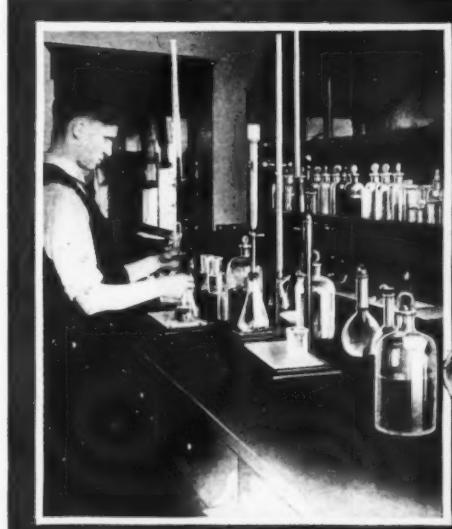


Arthur M. Leacock,
Chief Engineer

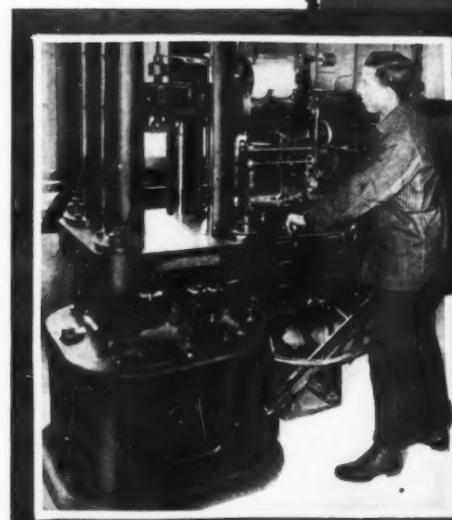
Manager of the engineering department



Samples from each lot of steel received are taken for the purpose of analysis



In the chemical laboratory. Here delicate scales and chemical analysis check their findings, against the original specifications



In the physical laboratory, where sample test bars are slowly pulled apart in order to determine tensile strength and the grain of the steel

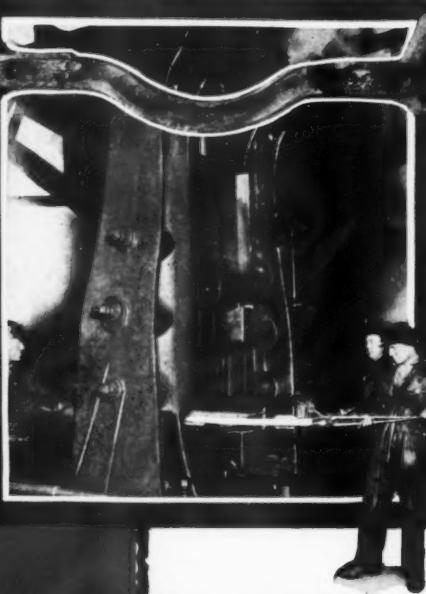


Supervisor of Production

It is Important to Remember That Sheldon Makes No Pleasure Car Axles nor Cheap or Low Grade Truck Axles. Sheldon Makes High Grade Truck Axles Exclusively; The Highest Priced Truck Axles Built in America



Building a Sheldon one-piece front axle. The first operation. A huge "bulldozer" with the weight of 200 tons first splits both ends of a big block of steel



Third operation. Mighty 6000-pound steam hammers die forge the big shaped bar into a single-piece I-beam axle bed or frame

A good front axle is a most vital unit of every good truck.

It insures safety and prevents accidents. It makes control easy and conserves manual effort at the steering wheel.

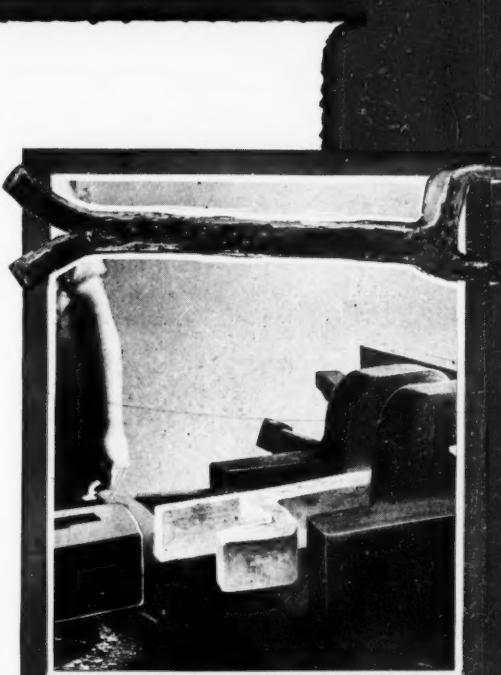
One-piece drop forgings, precise machining and fine materials are distinctive characteristics of Sheldon Front Axles.

Steering knuckles and steering levers are one-piece forged of Chrome Nickel Steel, annealed and carefully heat treated, then individually tested for hardness, toughness and strength.

Tie-rod clevises are drop forged. Ball pins, pivot bolts and clevis pins are hardened and then ground to limits as fine as those of a high-grade ball bearing.

The big Sheldon front axle beds are drop forged in one piece from a single bar of special axle steel. Sheldon never builds an axle from pieces of steel welded together, altho this is common practice in big axle construction.

Huge, costly, specially built machines and men of exceptional skill are needed to construct these ponderous one-piece axles, but the extra safety and strength obtained from this more expensive construction are well worth all that they cost.



Second operation. A "bulldozer" shapes the split ends of the bar, thus preparing the stock for the dies



After inspection, the forged axles are next annealed and then removed to the machine shop to be milled, drilled, ground and finished





*Drop Forging and Heat Treating
Play a Most Vital Part in the
Building of Fine Truck Axles*

*Edgar C. Price, President,
11 Years with Sheldon*

THERE are special reasons why Sheldon excels in the art of heat treating and drop forging high-grade steels.

This has been the business of Sheldon for nearly fifty years.

Consider, please, what 50 years of experience in this difficult craft really means.

It means learning of a kind that could never be crowded into a thousand different books. It means practical experience of a kind that cannot be measured in dollars and cents, and that can be achieved in no shorter time.

There is a science in heat treating and forging steels which can be mastered



only through years of extensive application.

Here in the Sheldon forge shops you will find many men who have spent their lives heat treating steels for Sheldon.

Some have served for forty years; many for over twenty-five.

This is their life, shaping molten masses of metal under the tremendous blows of big steam hammers. This is their sole craft, a heritage handed down from father to son.

The accuracy and speed with which these men shape white hot masses of

steel under 6000 lb. drop hammer blows is almost incredible.

In forging different article parts their sense of accuracy and proportion has become so developed through years of constant application that many can forge to within limits of a 32d of an inch without the aid of calipers.

Imagine shaping huge Sheldon axle parts under these huge hammers to within limits no larger than the thickness of a dime, without the aid of a measuring device, and more quickly than the metal can cool.

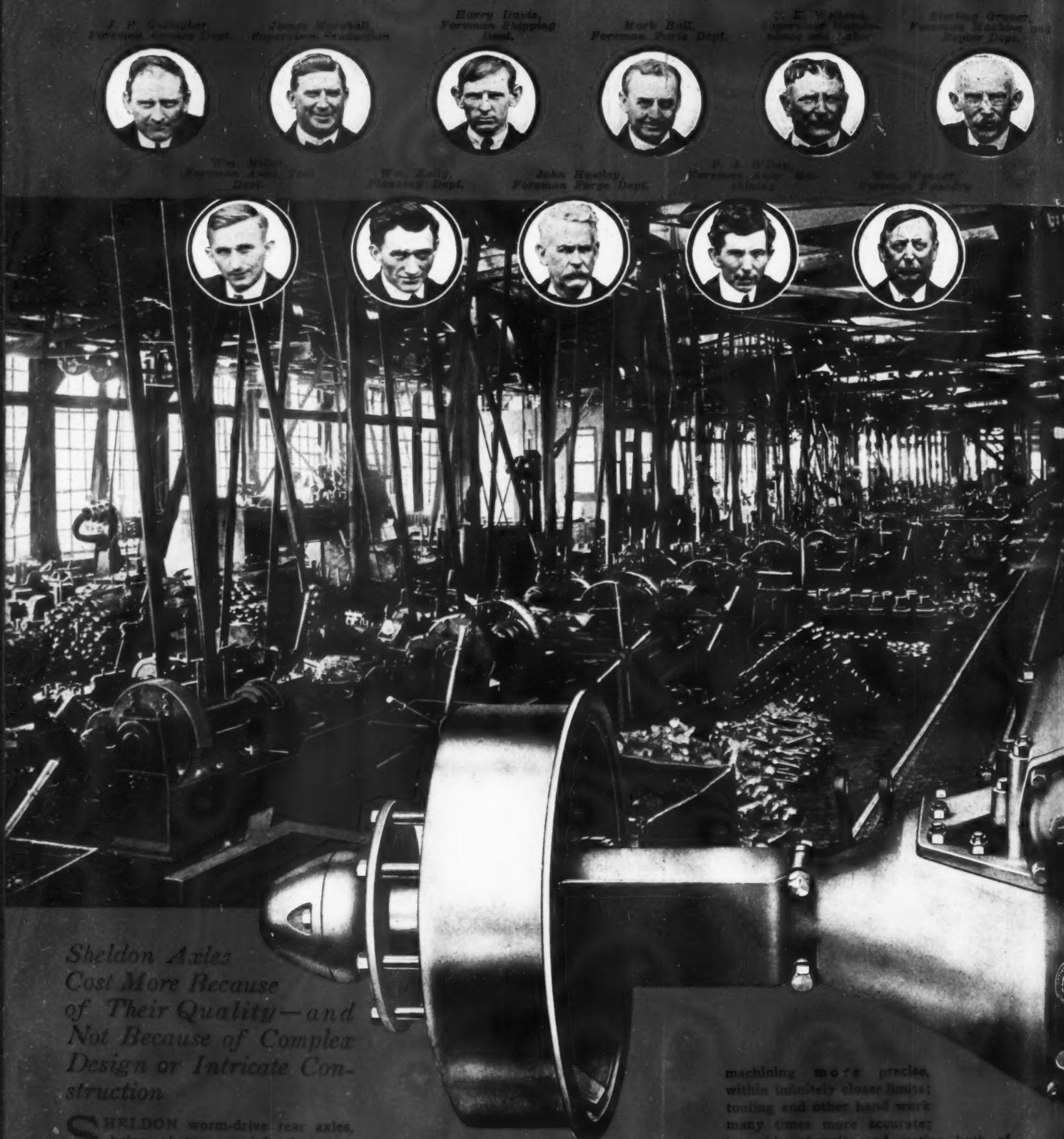
John Clark,
Hammerman,
27 Years Sheldon

Peter Swanson,
Hammerman,
Years Sheldon

Anthony Schucker,
Hammerman,
27 Years Sheldon

Joseph Holloman,
Hammerman,
Years Sheldon

John
Hammerman
31 Years Sheldon



*Sheldon Axles
Cost More Because
of Their Quality—and
Not Because of Complex
Design or Intricate Con-
struction*

SHELDON worm-drive rear axles, being of true semi-floating construction, are soundly simple in design. This design permits of a construction with a third less parts than usual, and requires considerably less weight of metal for the same given factor of safety.

The most intelligent factory supervision, combined with this economical and simple design and construction, helps to keep the cost of construction at the efficient minimum. With these basic factors

of cost kept at a low figure, wherein does the extra cost arise?

There is less metal—but the quality of that metal is out of all proportion to the saving of weight. Sheldon's definite high standards for steel cause the rejection of many tons of metal ordinarily called high-grade—none but the finest ever reaches axle form.

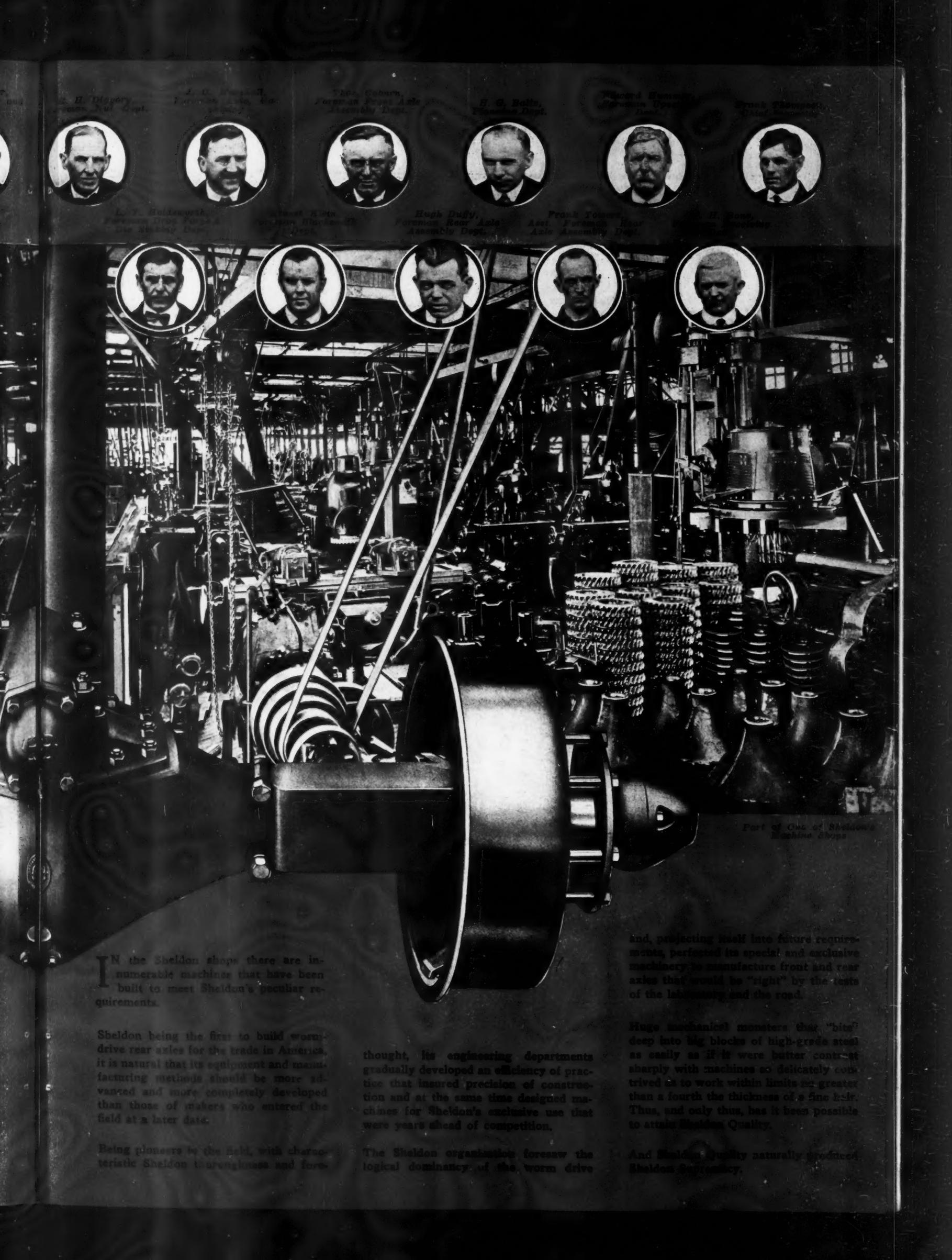
Factory efficiency cuts the cost of each operation—but the operations are finer—

machining more precise, within infinitely closer limits; tooling and other hand work many times more accurate; assembly of units and testing both of parts and finished axles more careful than any but the most thorough engineer can conceive.

Thus we say Sheldon Axles cost more, and the simple logic of the facts of production gives the reason.

Manufacturing Sheldon Axles so precisely and well makes their somewhat higher cost a great deal less than their value.

Their use is sheer economy.



IN the Sheldon shops there are innumerable machines that have been built to meet Sheldon's peculiar requirements.

Sheldon being the first to build worm-drive rear axles for the trade in America, it is natural that its equipment and manufacturing methods should be more advanced and more completely developed than those of makers who entered the field at a later date.

Being pioneers in the field, with characteristic Sheldon thoroughness and fore-

thought, its engineering departments gradually developed an efficiency of practice that insured precision of construction and at the same time designed machines for Sheldon's exclusive use that were years ahead of competition.

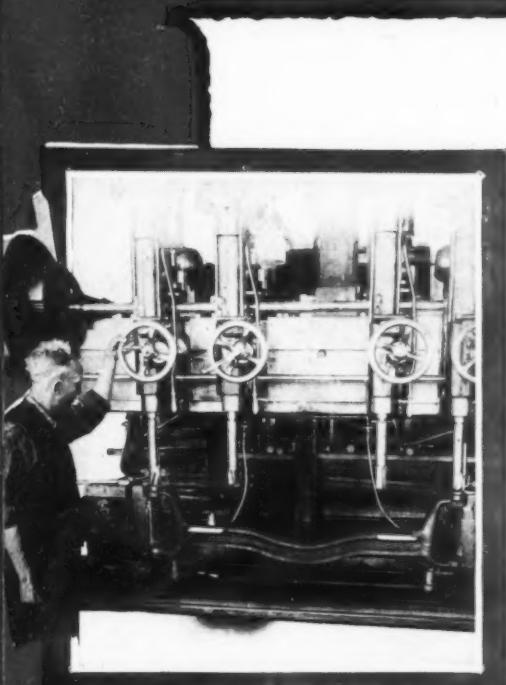
The Sheldon organization foresaw the logical dominancy of the worm drive

and, projecting itself into future requirements, perfected its special and exclusive machinery to manufacture front and rear axles that would be "right" by the tests of the laboratory and the road.

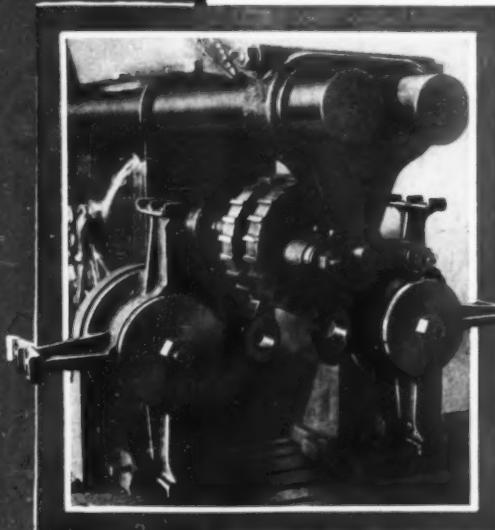
Huge mechanical monsters that "bite" deep into big blocks of high-grade steel as easily as if it were butter contrast sharply with machines so delicately contrived as to work within limits no greater than a fourth the thickness of a fine hair. Thus, and only thus, has it been possible to attain Sheldon Quality.

And Sheldon Quality naturally produced Sheldon Superiority.

It is Not Difficult to Design an Axle That is Strong. The Difficulty Lies in Combining Design and Strength (Plus a Suitable Factor of Safety) so that the Axle Will be Free From Friction.



Drilling front axle I-beam for pivot bolts. This machine drills all necessary holes—four in all—at one setting of the piece



Straddle milling four surfaces of two axle spiders (a complete set) at one operation

A monster milling machine specially built for Sheldon. Notice the big traveling carriage and the three vertical milling cutters. Three different surfaces are milled at once with this machine

FRICTION means wear. Friction means grinding contact.

Obviously, it is an axle's worst enemy.

Precise machining, proper design and unfailing strength are the only factors that can conquer friction, with its resulting wear, loose play and noise.

That is why every step in the making of Sheldon axle parts is carefully safeguarded and rigorously inspected. That is why only the finest and most modern facilities and equipment are used.

That is why Sheldon maintains such high standards and such close limits.

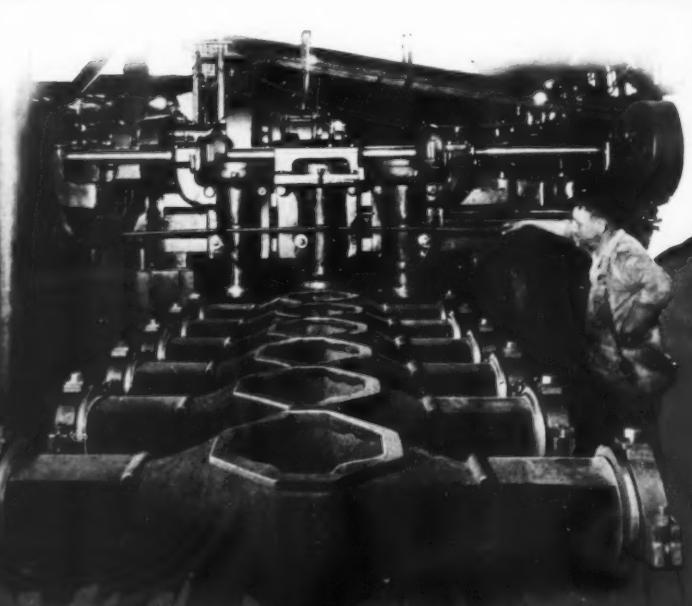
That is why Sheldon axles have become renowned for their quietness, smoothness and freedom from wear—why they deliver lower cost-per-mile haulage.



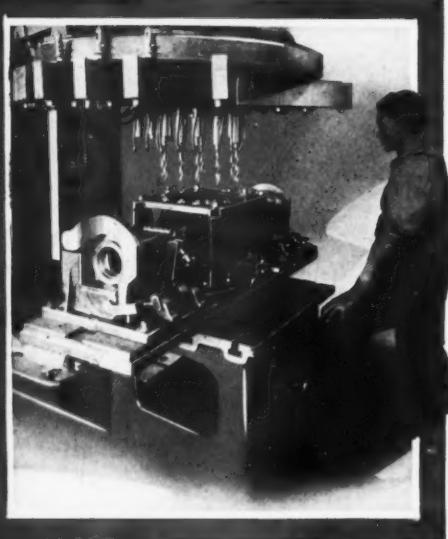
Worm gear axle carrier being bored for bearings. The extreme accuracy maintained insures permanent freedom from adjustments



The second operation of boring worm carrier is performed without once changing the position of the piece in its fixture. This is done in order to achieve absolute accuracy



The "Factor of Safety" in Sheldon Truck Axles Has Been Clearly Established; The Product of Experience and Engineering Skill



Drilling 12 stud holes at once in a worm gear axle housing



The big brake drums are trued up by means of grinders

THE finest scientific calculations are virtually helpless when it comes to determining the "factor of safety" in big truck axles.

Axles are units, assembled together. Each unit has a load, a pull, a strain, a thrust or a shock to bear.

Each unit must work in perfect harmony with the others to overcome the many destructive forces that are constantly trying to grind them to pieces or rip them apart.

If operating conditions were always the same it would be a simple matter to determine the strength each unit should have.

But load and road conditions vary. The speed varies. Drivers are different.

One bearing too small, one part too light or weak, will work destruction throughout an otherwise perfect axle.

Mathematics will indicate one thing, actual road performance will prove another.

Experience—the acid test of performance—alone can solve this vital factor.

Years of practical road performance has so clearly determined the proper "factor of safety" for all Sheldon axle parts that no slightest element of speculation remains regarding this important factor.

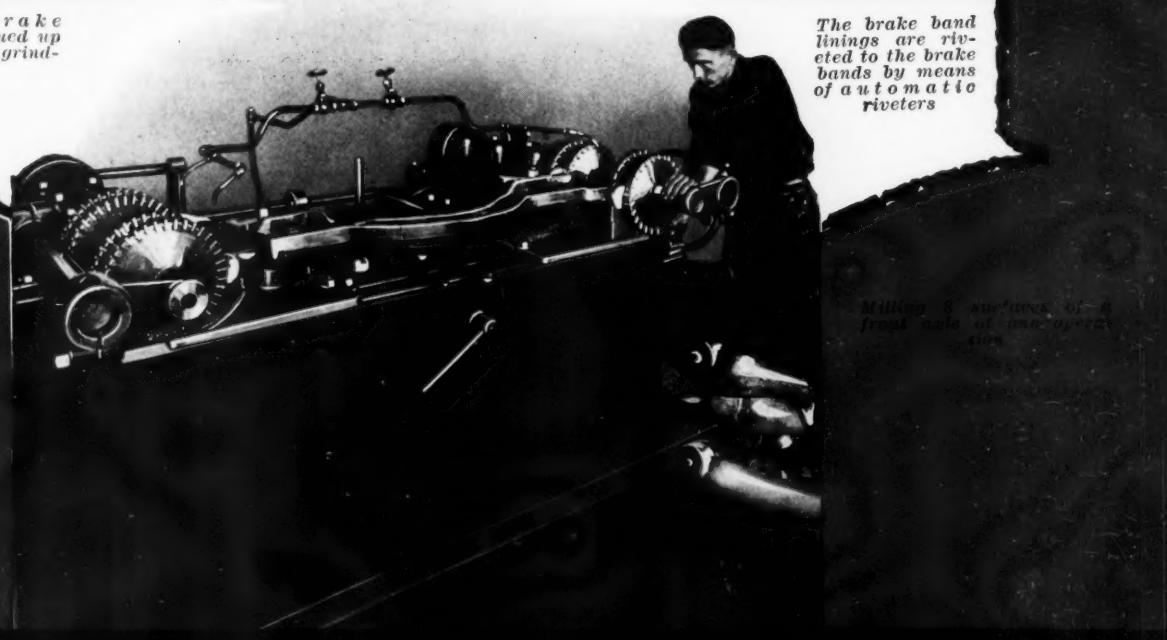
Thus is established another inherent advantage that Sheldon has because of its wider and longer experience in big axle building.



Punching brake band lining preparatory to riveting

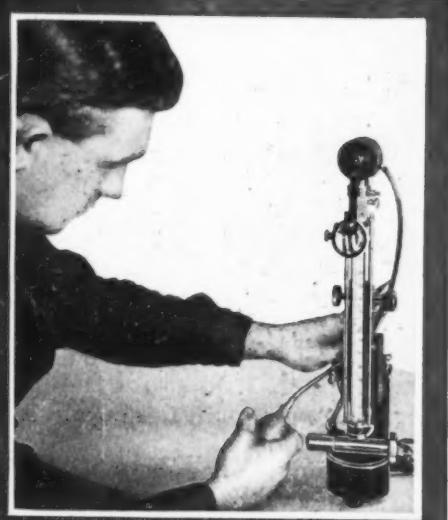


The brake band linings are riveted to the brake bands by means of automatic riveters



Milling 8 surfaces of front axle at one operation

To Insure Uniform Quality There is Rigorous Inspection and Supervision at Each Step in the Manufacture of Sheldon Axle Parts



The hardness of all small parts is carefully measured by means of the scleroscope

BUT even this is not enough to satisfy Sheldon standards. When each part is finished and ready for assembly it is given a final individual inspection of the most searching character.

Trained men with instruments of amazing accuracy seek flaws and test for hardness, strength and ductility. Nothing is left to chance.

When these tested parts are assembled, the result is a completed SHELDON axle, rugged in construction, easy running in operation and of established scientific excellence, costing more to build and to buy, but worth it.

An axle that is completely dependable, one that will stand the tests of continuously hard usage, one that will deliver long and uninterrupted mileage with a minimum of maintenance expense.

An axle sure to give lower cost-per-mile haulage.

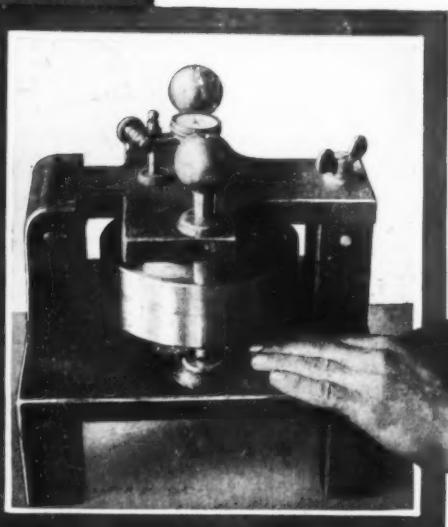
An axle whose quality makes it the highest priced truck axle in America—and worth all it costs.



Axle shafts and steering knuckles are individually tested for hardness by means of Brinell machines

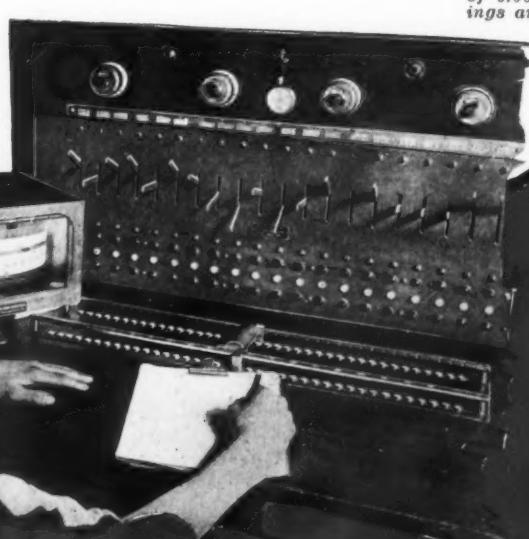


Gauging bearing seats on front axle spindle. These surfaces are held to limits of 0.0005" for outer bearings and 0.0010" for inner bearing seat



Testing thrust bearings for accuracy and proper clearance

Pyrometer control board by means of which the heat in each individual heat treating furnace is carefully monitored



There is a Big Advantage in Owning a Truck Equipped with an Axle Built by an Old Established Company



A fortune in bronze—a store of worm wheels. The illustration shows only a small part of those on hand



In the rough stores department where many thousands of tons of parts are kept

TRUCKS will meet with accidents. Occasionally they will meet with abuse no metal can stand.

Damage any part of a Sheldon axle and a wire will start a new part on its way to you within four hours.

This is Sheldon's idea of service.

There is no part of a Sheldon axle, no matter how obsolete the model, for which Sheldon does not carry duplicate parts for many years.

In this way, Sheldon makes sure that complete satisfaction will be given through the years of service to come to the fortunate owner of a Sheldon equipped truck.

* * *

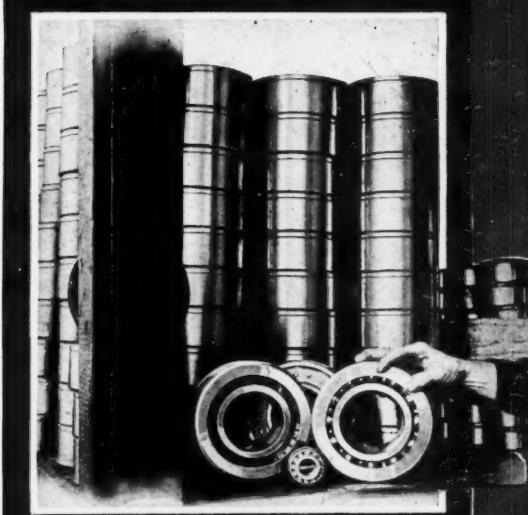
When buying a truck, look on the axle for the shop mark of Sheldon—the "double anchor."

It is the mark of a pioneer. It symbolizes half a century of manufacturing experience and progress. It is placed on all Sheldon products for the guidance and protection of buyers. The first worm drive axles made for the trade in this country bore the trade mark of Sheldon.

The big torpedo-like hub caps that you see every day on so many of the best makes of trucks are signs of Sheldon dominance in the worm drive axle field.

On these hub caps and on the axle housing you will always find the Sheldon trade mark.

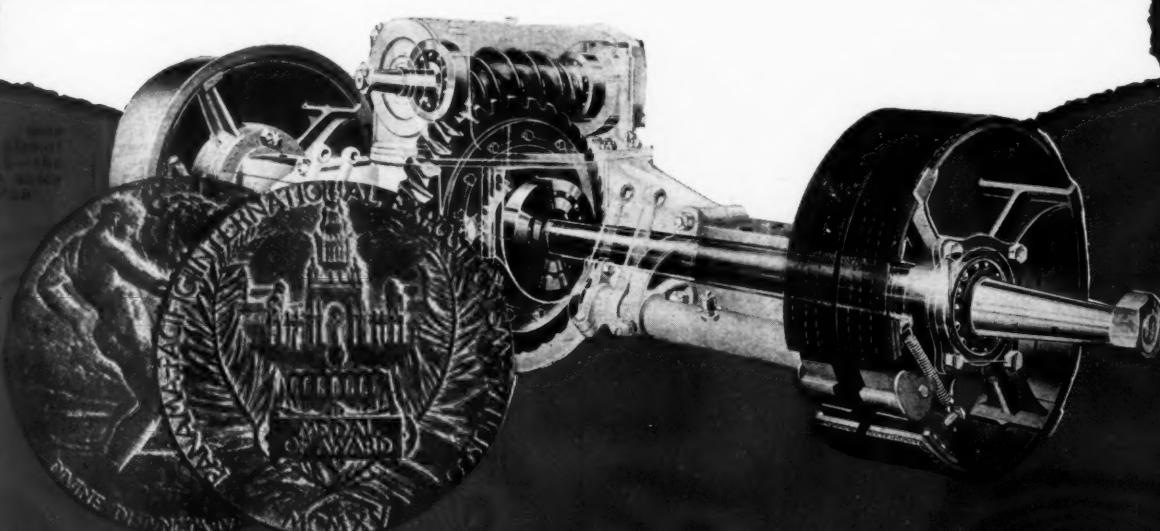
When buying a truck look for it. It is a pledge of satisfaction and a guarantee of low cost haulage.



Bearings. Many thousands of them are stored in this room

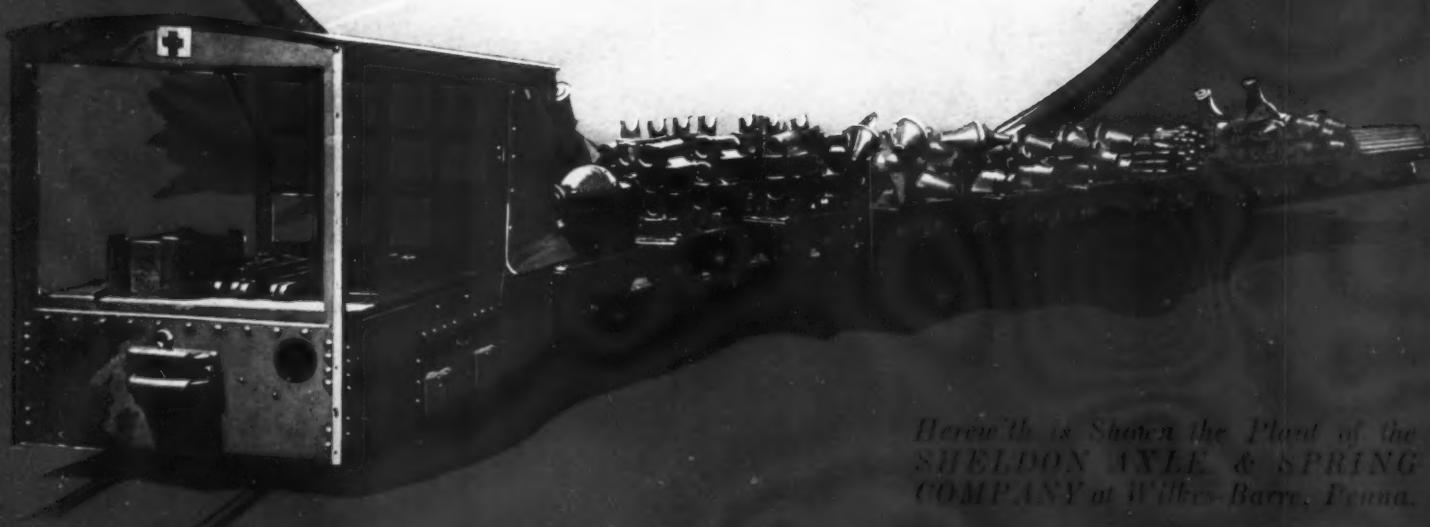


Hubs for 5-ton Sheldon front axles, before being machined. Notice their husky appearance



The gold medal awarded Sheldon, San Francisco, 1905—the highest award given to any American company at the World's Fair.

The Factory Behind The Axle



Herewith is Shown the Plant of the
SHELDON AXLE & SPRING
COMPANY at Wilkes-Barre, Penna.

SHELDON
AXLES



Over 1000
Gould Service
Stations
are equipped to give expert battery service

Over 2500
Gould Battery
Dealers
can supply a Gould Battery of correct size for any make of car

Look for Gould Signs



Five Great Navies Have Endorsed Gould Quality

And we are insuring it by manufacturing our own lead oxides at the Gould works in Depew, the only complete plant for building storage batteries from oxides to finished plates. By controlling the quality of our oxides we are now in a position to maintain Gould Quality at even a higher level than heretofore.

Experts know that the first essential of battery-quality is plate-quality. Gould Starting-Lighting Batteries possess a dominant fundamental advantage in Gould Super-Hard Plates, perfected nearly ten years ago and still unmatched for power and long-sustained capacity.

Gould Storage Battery Co.
30 East 42nd St., New York
Philadelphia Chicago
Cleveland Los Angeles
Detroit San Francisco
Works: Depew, N. Y.



Gould Super-Hard Plates

are also used in batteries for

Street Cars
Submarines
Railway Signals
Train Lighting
House Lighting
Power Plants

— wherever absolutely dependable battery service is required



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Trade Mark Reg. U. S. Patent Office.

NIGRUM

(Impregnated Wood)

Oil-less Bushing



Trade Mark Reg. U. S. Patent Office.

BOUND BROOK

(Graphite and Bronze)

Oil-less Bushing



There are two different kinds of Genuine Graphited Oil-less Bushings

ONE KIND IS MADE OF HARD WOOD, IMPREGNATED WITH LUBRICANT AND IS KNOWN TO THE TRADE AS "NIGRUM." THE OTHER IS A HIGH GRADE BRONZE BUSHING, WITH INSERTS OF GRAPHITE. IT IS KNOWN TO THE TRADE AS "BOUND BROOK"

NIGRUM

NIGRUM (Impregnated Hard Wood) Oil-less Bushings are made of selected hard wood, thoroughly seasoned and then thoroughly impregnated with our special lubricating compound.

This bushing not only has the advantage of running efficiently and lasting indefinitely without oiling or any attention whatever, but has the additional advantages of being light in weight. Its ability to absorb grit and dust without the slightest harm to itself greatly prolongs its own service life as well as that of the shafting.

NIGRUM Bushings, properly placed, have proved themselves of inestimable value in protecting machinery against the early breakdowns so frequently caused by bushings worn out for want of oil.

BOUND BROOK

BOUND BROOK (Graphite-and-Bronze) Oil-less Bushings are made of the finest Phosphor Bearing Bronze, so constructed as to retain a sufficient quantity of our specially prepared lubricating graphite to keep it constantly lubricated in service, even if neglected.

BOUND BROOK Bushings are used as an insurance against neglect. For machine parts that are inaccessible and therefore difficult or impossible to keep properly lubricated, it is the only sensible type of bushing to use.

Built to all other intents and purposes precisely like the best bronze bushings, they have the additional advantages of self-lubrication.

Oiling will not hurt these troubleless bushings, but they will give efficient service even if overlooked. And as the life of a machine is no longer than the life of its bushings the use of Bound Brook Bushings is positive insurance of long life and increased efficiency.

BUSHINGS



Endorsed and used by the United States Government in battleships, cruisers, and submarines.



Endorsed and used by the leading manufacturers of motor trucks.



Endorsed and used by the leading manufacturers of electric starting motors.

Endorsed By Leading Manufacturers

The leading manufacturers of Motor Cars, Trucks, Armored Cars, Aeroplanes and Tractors have endorsed these bushings and use them in their products.

The U. S. and several foreign governments have endorsed them through installation of bushings in Battleships, Destroyers, Submarines, Seaplanes and Aeroplanes.

For many years these oil-less trouble-less bushings have been increasing the service life and reducing the operating cost of many hundreds of different kinds and makes of machines, such as mill and factory machinery, windmills, gas engines, escalators, elevators, electric machines, mining machines, etc.

They invariably promote economy and efficiency of operation when properly installed.

Dependable Deliveries

The capacity of our plants at Bound Brook and Lincoln, N. J., is Ten Million Bushings per annum. This plant has every known facility for the manufacture of highest quality bushings in large quantities at short notice.

Situated half way between New York and Philadelphia on the Baltimore & Ohio, Philadelphia & Reading, New Jersey Central and Lehigh Valley Railroads.

Prompt deliveries are therefore assured.

We should be glad to advise with you concerning your own special bushing problems.

All Genuine Graphited Oil-less Bushings have always been made at Bound Brook, U. S. A.

BOUND BROOK OIL-LESS BEARING CO.

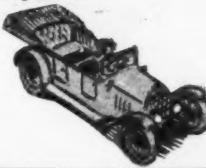
*Specialists in the Manufacture of Oil-less Bushings
for More than a Third of a Century*

BOUND BROOK

NEW JERSEY



Endorsed and used by the leading manufacturers of aeroplanes.

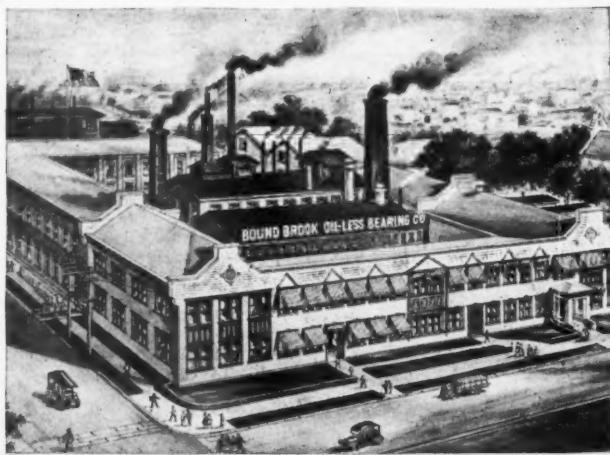


Endorsed and used by the leading manufacturers of pleasure cars.



Endorsed and used by the leading manufacturers of hundreds of different kinds of machinery in almost every line of industry.

The Plants of the Bound Brook Oil-less Bearing Company have an annual capacity of Ten Million Bushings



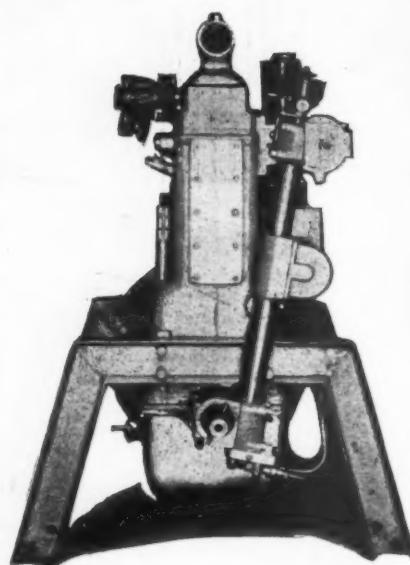
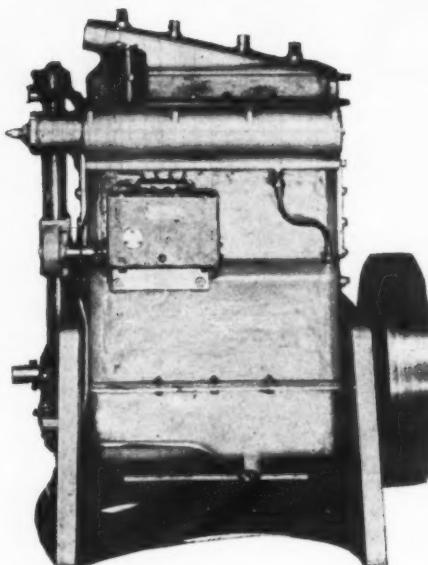


Illustration shows camshaft and oiler-driving shaft.

MOHLER SLIDE VALVE MOTOR

**Valve and Car-
bon Trouble
Absolutely
Eliminated**



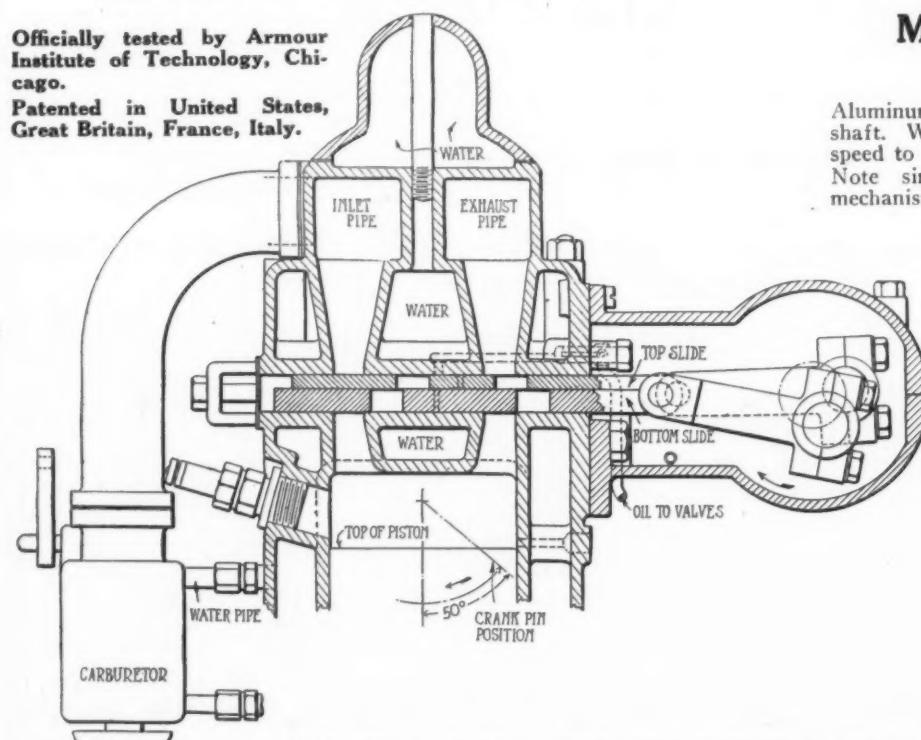
Showing auxiliary oiler fastened to side of engine.

Final word in gas motors. Valves thoroughly water jacketed on all sides. Perfect lubrication is secured through a distinct auxiliary unit.

This motor is the result of fifteen years' experience of intensive engineering. A power plant that is absolutely silent and more flexible than any poppet valve construction. This motor develops at least 25% more power for the valve area opening than the modern poppet valve engine.

Officially tested by Armour Institute of Technology, Chicago.

Patented in United States, Great Britain, France, Italy.



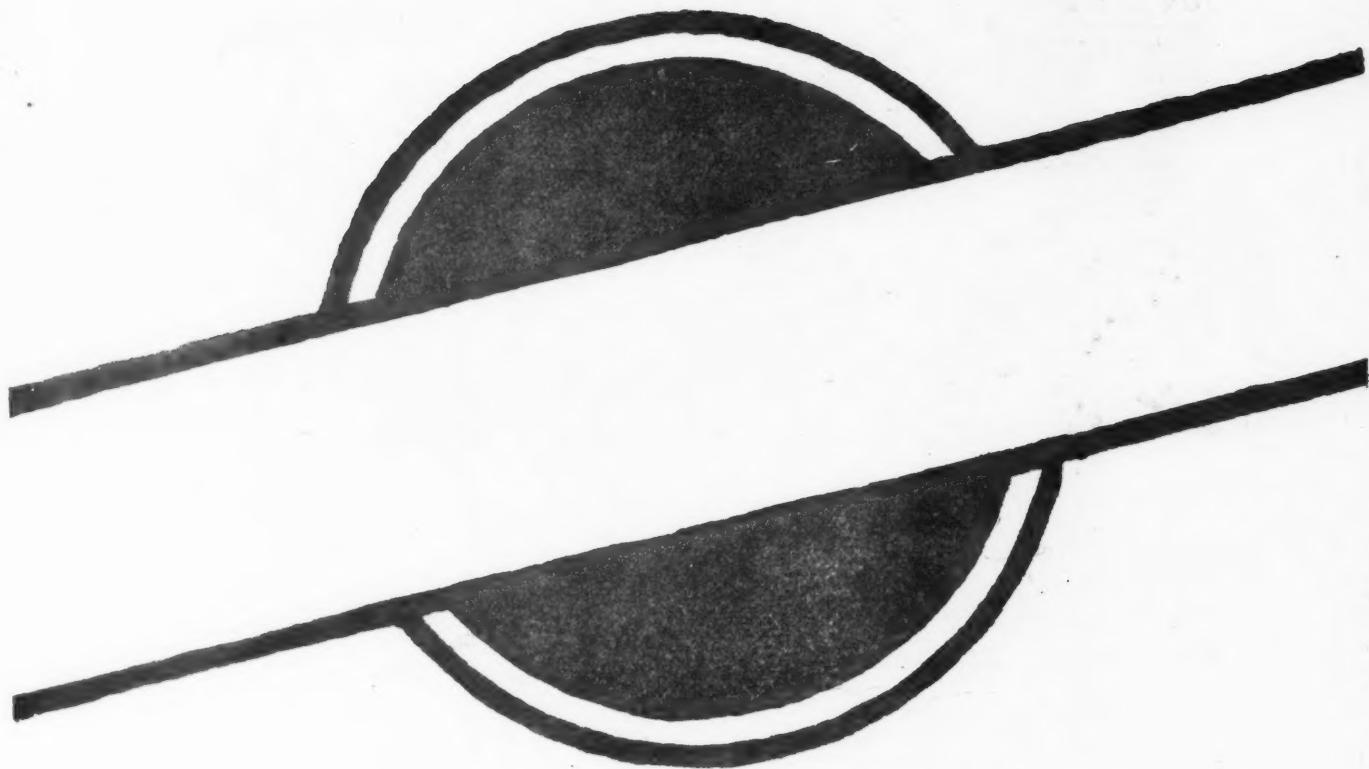
Section through top part of Mohler engine. The piston is shown on the explosion stroke with both ports closed.

Most Accessible of All Motors—

Aluminum Pistons. Counterbalanced crank-shaft. Will accelerate cold from lowest idling speed to over 3000 R.P.M.

Note simplicity of design. Entire valve mechanism can be exposed in ten minutes.

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to supplement its
passenger car—both
selling below \$800
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See announcement next week

For advance information wire or write MOTOR AGE,
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"Confidential" will be answered direct by MOTOR AGE
and so treated.

*"My! But that
Leatherwove is good looking."*



CHASE
Leatherwove
*"Tis like the hide in most respects
In some respects 'tis better"*
Upholstery

Scores of designs and weights
for all requirements

IF you want the best in a rich-appearing, long-wearing upholstery material and want results without experiment—loss of time and money—use LEATHERWOVE.

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can be used to advantage
practically wherever leather
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The leather problem is solved by
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wherever used. No cracking or
blistering. Weatherproof and
durable.

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Leaders in Manufacturing since 1847

The Top of Today—DREDNAUT

CHASE DREDNAUT Motor Topping

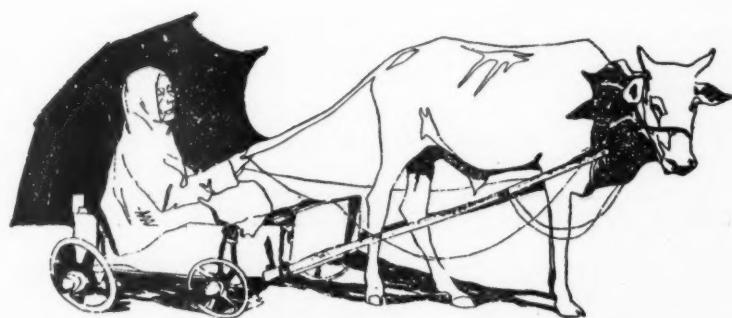
"Defies time and the elements"

Comparison—The Philippine woman doubtless thinks she is "going some" with her one-woman top. She has never seen Drednaut Motor Topping and can therefore make no comparison.

But you are in a position to compare Drednaut with others. It enhances the beauty of every car it is used on—*More Chase Material is used on vehicles today than any other brand.*

Don't experiment with an inferior brand.

We invite comparison and will gladly send samples for your consideration.



Philippine Roadster—1898 Model, With One-Woman Top.

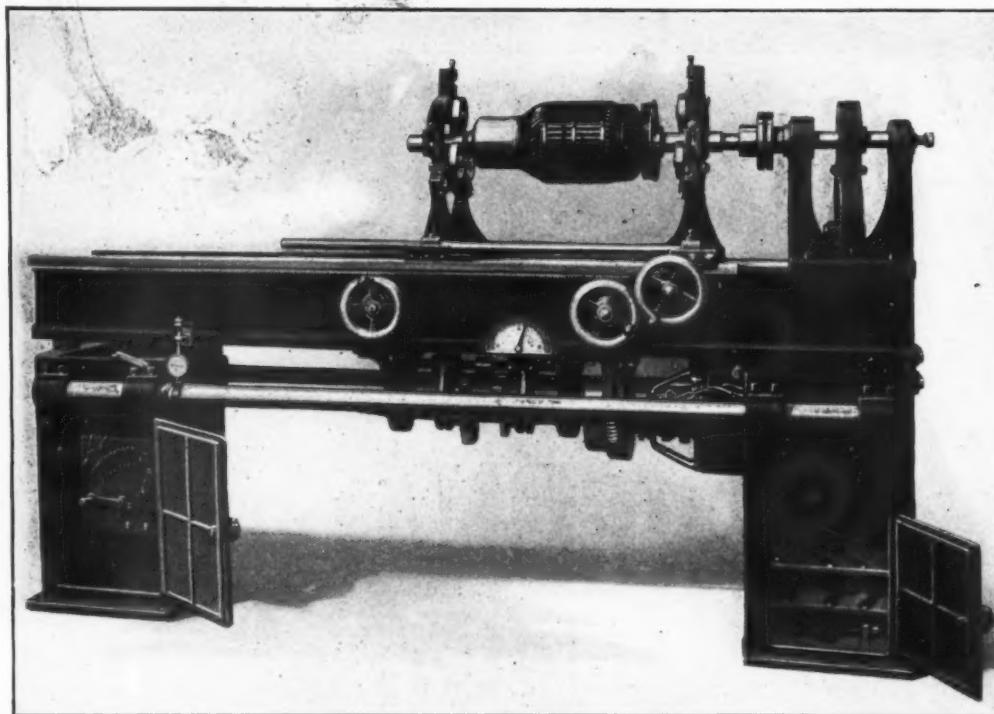
L-C-CHASE & CO-

BOSTON

DETROIT

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Leaders in Manufacturing since 1847



Now Ready! The New

CARWEN

Dynamic Balancing Machine

(Akimoff Patents)

Embodies the basic principles of the Akimoff machine described at the Annual Meeting of the S. A. E. last January; but is so arranged that all adjustments can be made without stopping the machine, simply by turning the two lower hand-wheels.

The Carwen Dynamic Balancing Machine is used for putting motor crankshafts, armatures, turbine rotors, etc., into perfect running balance. It rapidly and accurately determines—

- (1) the plane of unbalance,
- (2) the amount of unbalance.

Its readings are converted by a simple chart into exact diameter and depth of two holes, which are drilled at specified radius from the axis and specified distance apart. The object is then in balance. For 6-throw crankshafts three holes are drilled.

In repetition work one Carwen machine will easily handle 100 automobile crankshafts in an 8-hour day. No special skill is required.

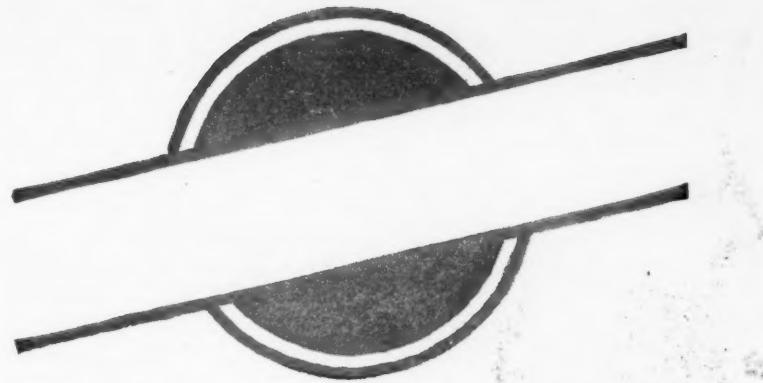
We are accepting orders for summer delivery. Descriptive booklet will be sent on request.

THE CARLSON-WENSTROM COMPANY

Richmond St. at Erie Ave.

Philadelphia, Pa.

Makers also of Carwen Double Row Ball Bearings

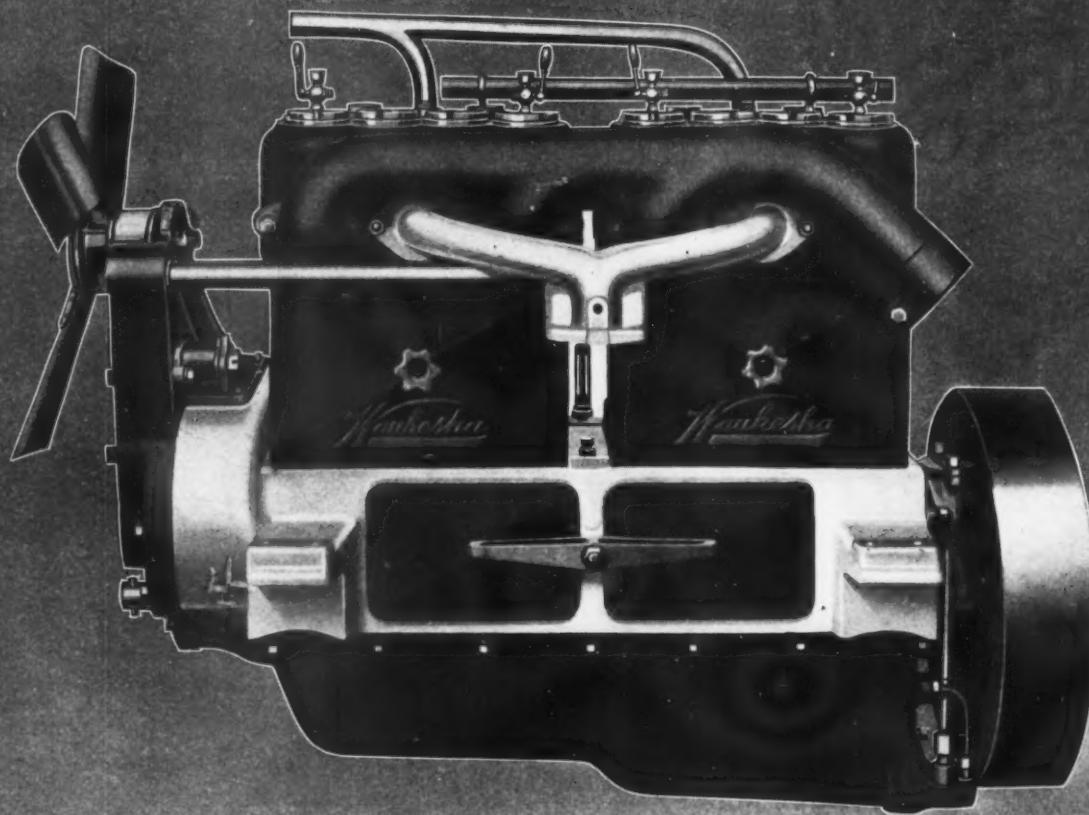


Big dealers
and distributors—
small dealers and
distributors—share
alike in the in-
terest, cooperation, the sell-
ing support of the parent
company.

**This company is now
spending hundreds of
thousands of dollars to help
its dealers and distributors
make *more sales* and
greater profits.**

See announcement next week

For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.



Integrity, Not Volume, is the True Test

With a full realization of the customer's dependence upon the manufacturer's integrity, it has ever been the policy of this organization to produce only motors that will fully sustain the unfailing faith placed in the name "Waukesha". That is why

Four-Cylinder Motors for Trucks and Tractors

are accepted with the fullest measure of confidence by builders and users of trucks and tractors. The performance of the product is in keeping with the high ideals of the makers.

"Demand a Waukesha Motor in the Truck or Tractor You Buy"

Manufacturers and Prospective Buyers will be furnished full information upon request

WAUKESHA MOTOR COMPANY, Waukesha, Wis.
World's Largest Builders of Truck and Tractor Motors Exclusively.

ARTHUR L. MORSELL,
MEMBER OF THE BAR & U. S. SUPREME COURT
PATENT COUNSEL & SPECIALIST

CHAS H. KEENEY
MECHANICAL ELECTRICAL
EXPERT

L. O. FRENCH
REGISTRATION ATTORNEY
U. S. PATENT OFFICE

MORSELL, KEENEY & FRENCH
SOLICITORS OF PATENTS
SUITE 814 MAJESTIC BLDG.
PHONE GRAND 1404
MILWAUKEE

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PATENTS
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BRANCH OFFICE
ROBINSON BUILDING
PACIFIC 9-1114

April 23, 1917

Clum Manufacturing Co.,
Milwaukee, Wisconsin.

Gentlemen:

Following your instructions, we have carefully examined patents to Marshall No. 696,180, March 25, 1902, Burnett No. 841,844, January 24, 1907, and Cox, No. 1,015,700, January 23, 1912, for Key Operated Switches for Automobiles.

We understand that you control these patents and desire to advise the automobile industry of this fact, and also advise said industry as to the scope and breadth of said patents, particularly as you intend to protect your patent rights. We are familiar with the patents mentioned and also with the prior art in this line.

The Marshall patent issued in 1902 appears to be the pioneer among Key Operated Switch Patents for Automobile use and its claim 2, which is as follows:

"2. In an electric switch the combination with mechanism for operating the switch, of a key-controlled locking mechanism constructed to lock said switch in either of two positions."

In our opinion broadly covers all forms of Key Controlled Switches for Automobile use now on the market.

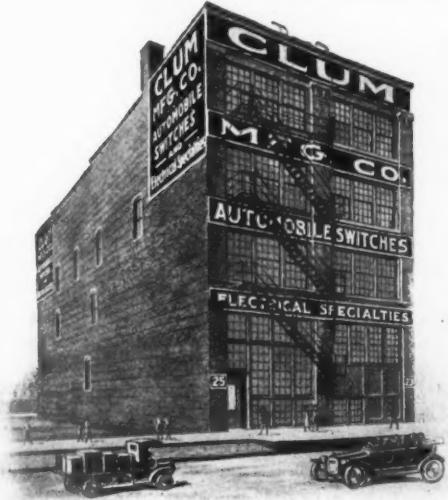
The patents to Burnett and to Cox although dominated by the above claim also contain claims broad in scope which cover the present day form of automobile switches, and we cannot conceive of any form of Key Controlled Lock Switch for Automobile use, which would not come within the terms of some of the claims of these patents.

Trusting that this letter will give you the desired information, we remain

Yours truly,

Morsell Keeney & French,
Per *Chas H. Keeney*

CLUM KEY OPERATED SWITCH AND PANEL BOARD EQUIPMENT IS MOST SATISFACTORY



We take this means of notifying automobile and accessory manufacturers of our patent rights and facilities, believing same sufficient to merit proper recognition.

Our new factory is now completed and operating. Our facilities are quadrupled. We can handle your business promptly and properly, with a variety of products to meet your every requirement.



Combined Ignition
& Lighting Switch

CLUM MANUFACTURING CO. Milwaukee, Wisconsin

GENERAL SALES OFFICE, 1831 Dime Bank Building, Detroit

ANDERSON

SIX

Three Years' Performance has Established the Mechanical Excellence of Anderson Cars Beyond Any Possible Question of Doubt

FIRST, we built the Anderson SIX of the finest and best known mechanical units.

To this we combined real engineering design, fine workmanship and a sincere determination to build a car worthy of our 28 year old reputation of doing things well.

Then, in order to outstrip competition completely, we added custom built bodies.

This is no mere advertising talk, no over strong claim.

When it comes to body designing and building we have a decided economic

advantage over other motor car manufacturers.

For twenty-eight years we have specialized in the production of fine coach work. Few body builders have better facilities, more able designers or longer or wider experience in this difficult craft.

You know at a glance that Anderson bodies are custom built. They possess that character and fashionable originality that is peculiar to high priced cars. You see it in the lustrous finish, in the upholstery, in the lines, in the solid substantial construction, and above all, in the originality of design.

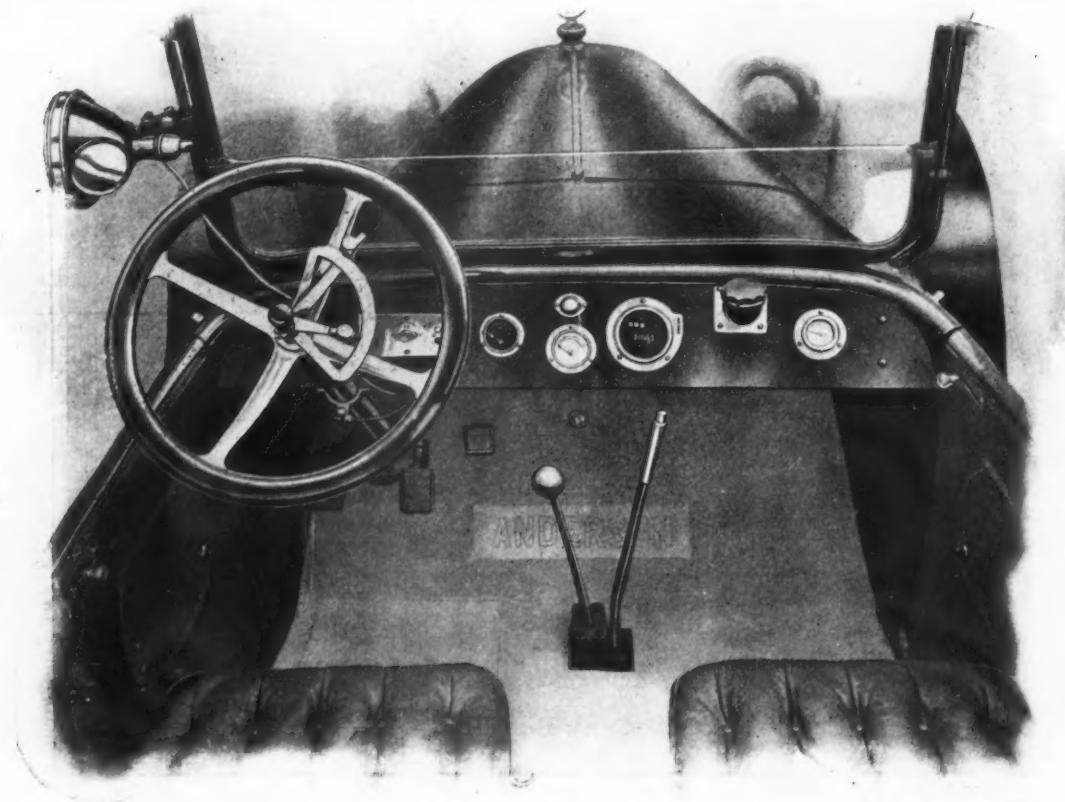
DEALERS:

Here is a car with which to meet war time conditions.

It comes within the popular price limit, yet possesses unusual mechanical excellence, is built entirely of units well known and highly regarded by the public, and has the lines, character and finish you expect to find only in the highest priced cars.

Three years of performance has established its ability to successfully stand up under the hardest service. Its performance will compare favorably with that of any stock car built. It is light in weight—2750 lbs.—economical of gas and tires and an extremely comfortable car to drive.

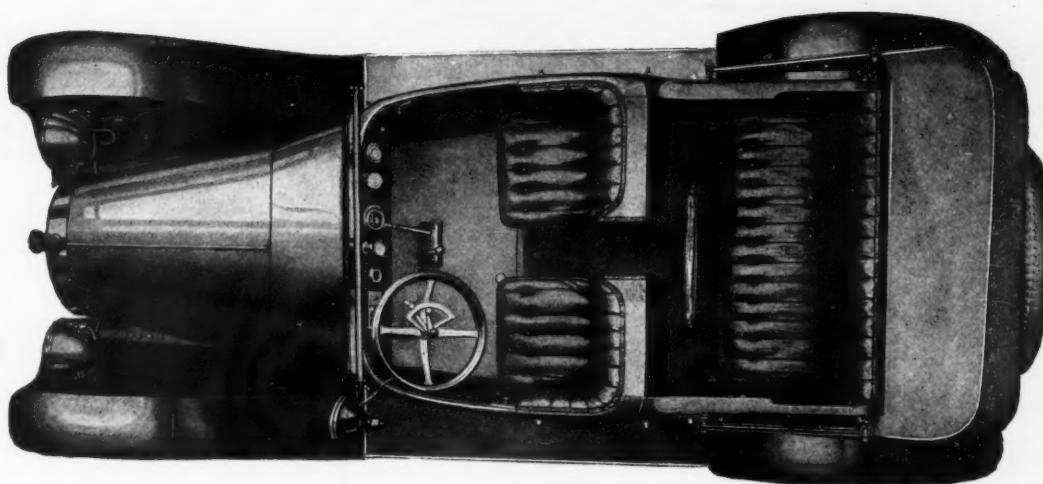
The material situation is now so acute, a price change will be necessary any day. To avoid disappointments in delivery at the present price, we would urge you to investigate at once. A wire will bring full particulars.



Notice the clean sweeping lines forward and the simplicity and comfort of control provided for the driver. The steering column is large, full 18 inches across. The foot pedals are big and roomy. The Gear Shift lever and emergency brake are conveniently close; the driver need never shift his position to reach either. For convenience there is a large size BOYCE MotoMeter, a HAWTHORNE spotlight, a KLAXON motor driven horn, a gasoline gauge and an oil gauge on the dash, a STEWART Speedometer, Dimmer switches, a Tonneau light and muffler cut-out. The windshield is adjustable from the driver's seat. For comfort the seats are cleverly tilted and thickly upholstered with real curled hair covered with real leather.

*Convertible Sport
Model*

It combines in one model a low, racy roadster and a big, roomy 5-passenger touring car, easily convertible from one to the other in a moment



The convertible feature of the Anderson sport car is fully protected by patents.

—An Exclusive Anderson Achievement

The Convertible Sport Car

Specifications

The chassis, equipment and accessories are the same in all Anderson cars—only the body designs are different.

Continental Six motor—Westinghouse Electrical equipment—Zenith carburetor—Borg & Beck clutch—Full floating rear axle with noiseless spiral differential gears.

Gemmer irreversible worm and gear—tires 33 x 4. Non-skid on rear—120 inch wheelbase—Pressed steel chassis frame, 4½ inches deep.

Extra large springs, semi elliptic, underslung, 56 inches in rear, 36 in front—all wiring armored throughout—Upholstery of real curled hair, covered with real leather. Bodies custom built by Anderson, frames of dry seasoned oak and ash, sawed to shape, no steam shaped wood used.

Finish, hand applied and hand rubbed, involving 21 different operations in all, insuring a lasting lustre such as is given only the finest custom built bodies.

Weight 2750 lbs.

PRICES

Convertible Sport Car, Model 200 B... \$1,295

Five-passenger Touring Car, Model 200

A 1,295

(With divided front seats.)

Five-passenger Touring Car, Model 200

C 1,295

(With straight front seats.)

Houk Wire Wheels, 5 to a set, extra. 100

Special colors, extra 34

IT remained for Anderson designers to create the first *Convertible SPORT CAR*—the car that can be converted in a moment from a rakish roadster which, presumably, can accommodate but two, into a big roomy touring car with ample seating capacity for five.

It's an all 'round car—two cars in one—an accommodating car that meets the needs of every occasion and every purpose that can be met by touring car or roadster.

It's a great car for women who drive. It's the ideal car for young business men. The lines are rakish and smartly graceful. It has a quiet, supple motor that's miserly with gas, unconquerable on the hills, quick-as-a-flash on the get-a-way and with a speed of from 2 to 60 miles an hour on high.

Still it's a family car. In a moment's time it can be made to accommodate five; a child can do it. As a touring car it is big, roomy and comfortable. There is plenty of room for feet and knees, just as there is plenty of room for arms and elbows.

You must see this car to appreciate its unusual utility and rare charm; its fashionable smartness, its originality of design, its beauty of lines and finish. You must ride in it to appreciate its luxurious comfort, its powerful nimble footed motor and its unusual economy.

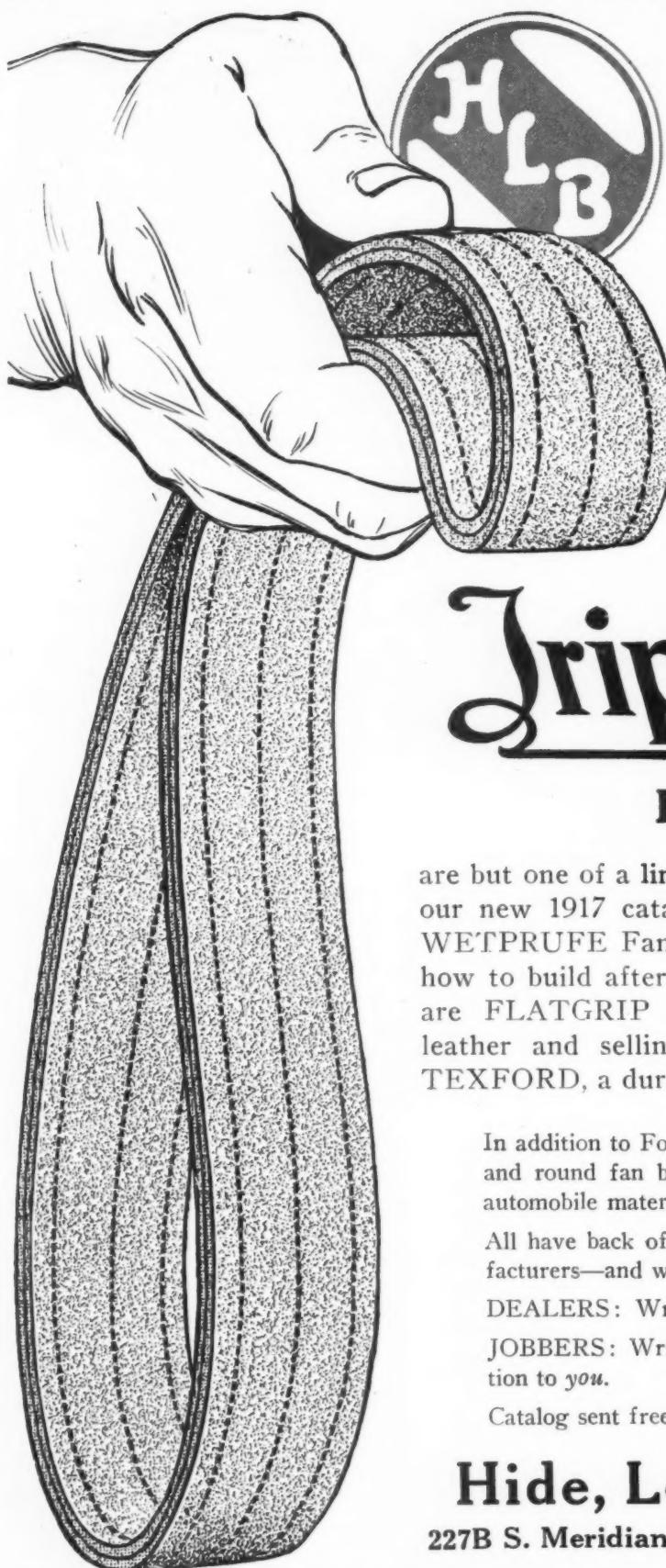
Regular Equipment

Perfectly equipped with every accessory that will add to safety or comfort;

KLAXON motor driven horn—KELLOGG engine driven tire pump—BOYCE Moto-meter, large size—STEWART speedometer—Oil and Gasoline Gauge on dash—HAWTHORNE "Old Sol" combination spotlight and trouble lamp—Combination tonneau heater and foot rest—Heavy, smartly tilted, two-piece, ventilating windshield—One man top of Special Anderson design—equipped with quick inside attachable storm curtains—five demountable rims—tire carrier—license brackets—jack and full set of tools.

ANDERSON MOTOR COMPANY, Rock Hill, South Carolina

Please mention **THE AUTOMOBILE** when writing to Advertisers



Big Profits From this Ford Fan Belt

Here's a Ford Fan Belt that sells at a remarkably low price—TRIPLE STITCH—a fan belt made of two plies of oak-tanned leather stitched with three rows of waxen linen thread—a fan belt that offers you unusual possibilities of profit.

Triple Stitch

Ford Fan Belts

are but one of a line of Ford Fan Belts pictured and described in our new 1917 catalog, now ready to come to you. There are WETPRUFE Fan Belts for Fords—the best fan belts we know how to build after almost fifty years of experience. Then there are FLATGRIP Ford Fan Belts—made of special fan belt leather and selling at a moderate price. And finally comes TEXFORD, a durable **all-textile** Ford Fan Belt.

In addition to Ford Fan Belts there are fan belts for *all* cars, flat "V" and round fan belting in rolls, clutch facings and other dependable automobile materials.

All have back of them the endorsement of leading automobile manufacturers—and will fully satisfy your customers.

DEALERS: Write for our catalog, with name of jobber nearest you.

JOBBERS: Write now for catalog with details of our special proposition to *you*.

Catalog sent free and gladly. Write now.

Hide, Leather & Belting Co.

227B S. Meridian St.

Indianapolis, Ind.

TEAR OFF AND MAIL

Gentlemen:

Please send me your new 1917 catalog, with name of jobber nearest me. I am particularly interested in the items checked below:

Flat Fan Belting
 Round Fan Belting
 "V" Fan Belting

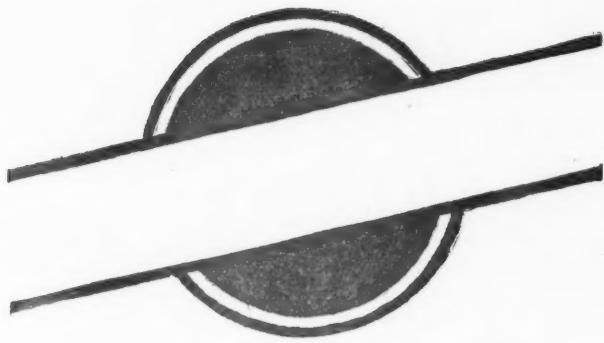
Made-up Fan Belts for Fords
 Made-up Fan Belts (all cars)
 Rawhicle lacing

Flexible Metallic Tubing
 Crank Holders, etc., etc.

Name

Address

A.-6-28

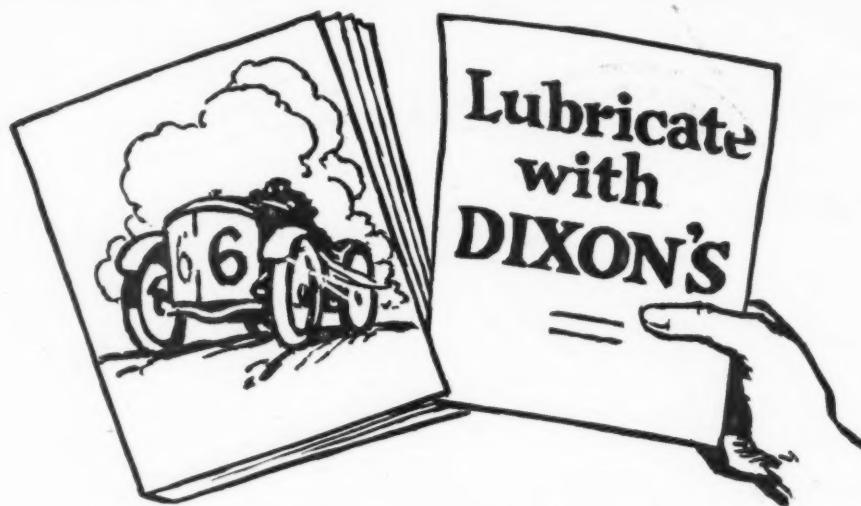


The South is
the fastest developing section of the United States today—and a most promising one for dealers and distributors who handle this nationally known 5-passenger car and one-ton truck, both priced at under \$800.

See announcement next week



For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.



Take a Leaf From the Racers' Book

Once more a Dixon-lubricated car has demonstrated Dixon dependability. Earl Cooper, winner of the 250-mile Chicago Speedway Derby, says, "Dixon's Graphite Automobile Lubricants are about as necessary to a racing car as gasoline."

DIXON'S GRAPHITE Automobile LUBRICANTS

have won the following "firsts" this year:

Driver	Car	Track	Date
Billy Taylor	Newman Special	Uniontown, Pa.	May 10
Louis Chevrolet	Frontenac	Cincinnati	May 30
J. P. Fetterman	Peerless	Uniontown, Pa.	May 30
Dave Koetzla		Detroit (dirt track)	May 30
Earl Cooper	Stutz	Chicago	June 16

Not only have Dixon's been used in the winning cars, but nearly every contesting car was kept Friction-free by Dixon's. Practically every racing driver of note uses Dixon's regularly. The drivers demand the very best for their cars and they are in a position to get it.—and—The superior lubrication is the reason for their choice of Dixon's, and the repeated Dixon victories are proof of that superiority. Here's something for the everyday driver of pleasure or commercial cars to remember: Dixon's prevent that metal-to-metal contact which makes Friction, and Friction spells ruin to your car. Get rid of Friction by lubricating with Dixon's.

Write Department 110 for the Dixon Lubricating Chart.

JOSEPH DIXON CRUCIBLE COMPANY
JERSEY CITY, N. J.



Established 1827.



A TRULY GREAT
AMERICAN INSTITUTION

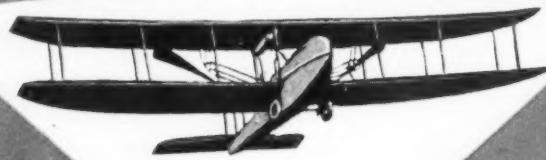


SPLITDORF

IGNITION
DEVICES

*The only thoroughly
American manufacturer
producing a complete
line of devices for
gas engine ignition
purposes*

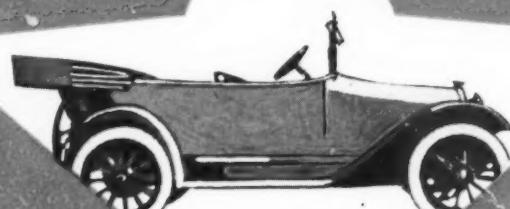
SPLITDORF



AEROPLANES



MOTOR TRUCKS

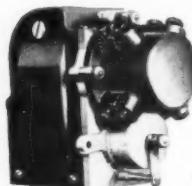


MOTOR CARS

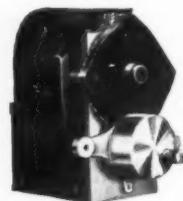
S. A. E. Standard Dimensions are used throughout

AEROPLANES

The first National Exhibition of aeroplanes held in America demonstrated the ignition choice of the majority of manufacturers—over 80% of the exhibits were DIXIE equipped. And DIXIE Magneto are being manufactured in quantity, today, to meet the U. S. Government demand as well as the demands of Allied Governments for "eyes of the Army and Navy," as aeroplanes are now termed.



DIXIE
8-cyl. Magneto



"The Ideal
Ignition System"

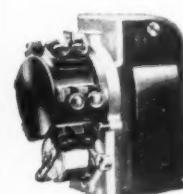


DIXIE Magneto are standard equipment on many of the best known makes of trucks in the country. "Fours" predominate.

To meet the war-time demand when trucks are away from all chance of service as generally understood, SPLITDORF has arisen to the occasion by devising and producing "The Ideal Ignition System."

This system provides two independent sources of current—DIXIE high tension magneto and battery timer and distributor, and either can be used as occasion may demand. Both sources fire through the same set of plugs without complication.

The SUMTER Starter Coupling, too, is a newer development available in this field. It is a purely mechanical device, designed for use with the DIXIE Magneto and does away with the necessity for dual and auxiliary battery systems, where safe, sure and easy starting is required.



DIXIE
12-cyl. Magneto

MOTOR CARS

DIXIE high tension magnetos—4s, 6s, 8s, and 12s represent the ultimate in ignition requirements for pleasure cars where the utmost of a motor's capacity for power and flexibility is essential.

In the development of ignition devices for pleasure cars, as well as other lines in the internal combustion engine field, however, scientific experimentation and research have had to go hand in hand with economical progress and the Model D SPLITDORF Timer-Distributor represents a distinct advance in these lines.



A Size and Type for Every Engine

SPLITDORF Plugs are made in all sizes and in types to suit every car, truck, motorcycle, motorboat, aeroplane, tractor, or stationary engine. They may cost more than the plugs you are using but they're well worth what they cost.

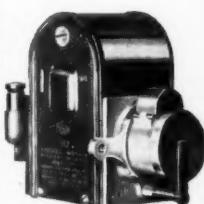
IGNITION DEVICES

S. A. E. Standard Dimensions are used throughout

MOTOR CYCLES

DIXIE Magnetos are supreme in the motor cycle field, the "singles" and "twins" of international fame equipped with them being legion.

DIXIE simplicity of construction, its accessibility, its dependability under all stress and rack of road and track strain—the quick pick-up and instant get-away inherent to it—have made it a household word for ideal ignition.



DIXIE
2-cyl. Magneto



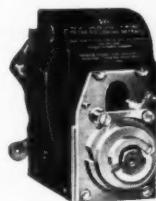
MOTOR CYCLES

TRACTORS

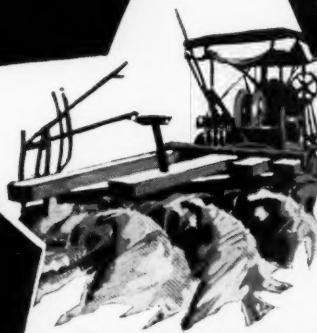
DIXIE Magnetos are naturally taking a tremendous hold in the tractor field by reason of their basic efficiency. More than a third of the tractors manufactured are DIXIE equipped.

And in the tractor field, as well as in the line of marine and stationary engines of too large a size to be easily rotated at sufficient speed to enable the magneto to produce a satisfactory volume of ignition current to start, the SUMTER STARTER COUPLING has been designed to make the starting of the largest engines, directly from the magneto safe, sure and easy.

Some of the biggest tractors have this STARTER COUPLING as standard equipment as the manufacturers prefer it to the complication of any starting battery system.



DIXIE
4-cyl. Magneto with
SUMTER Starter
Coupling



TRACTORS

SUBMARINE CHASERS

In the marine field DIXIE Magnetos have an assured place of prominence and the big low-tension SUMTER Type "AGD" Magneto has been adopted by a large and well-known heavy duty marine engine manufacturer.

The United States and foreign countries are using it in Government submarine chasers and in coastal service.



SUMTER
Type "AGD" Low-
Tension Magneto



SUBMARINE CHASERS

There's no broken porcelain to cause trouble and expense with SPLITDORF PLUGS.

The imported ruby mica core of Splitdorf plugs gives to them an efficiency and a long life that cannot be hoped for from porcelain cored plugs.





SPLITDORF SERVICE

SPLITDORF SERVICE
starts with the designing and construction of ignition devices that'll stand-up under any and every test for the manifold usages to which they are applied.

Production facilities of ample scope to take care of the volume demand, spells the kind of SERVICE the manufacturer must have be he identified in the aeroplane, truck, pleasure car, motorcycle, tractor, marine or stationary engine fields.

And these production facilities for ignition devices are taken care of in huge factories, equipped to the minute with automatic machinery and manned with skilled and trained mechanics at Newark, N. J., Sumter, S. C. and Torrington, Conn., with ample resources to keep ahead of every demand.

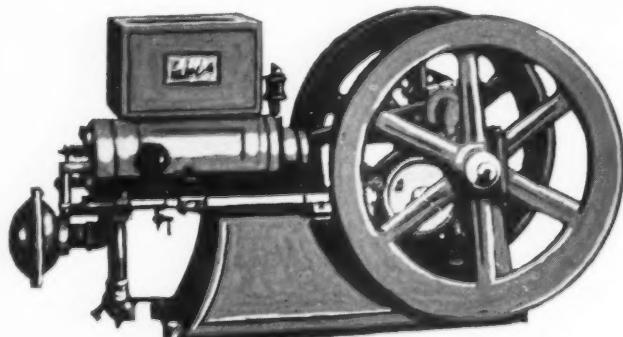
And once the manufacturers' wants are taken care of, the IGNITION SERVICE to the ultimate consumer, the fellow on the road, the farmer in the field—by air, land and water, SPLITDORF and SUMTER SERVICE is rendered by direct BRANCH HOUSE representation.

The wants of the aviator—the automobilist, the motorcyclist, the marine engineer, the truck driver no less than the hired man and the farmer, displacing horse toil with gasoline power—all are filled in the ignition field with SPLITDORF and SUMTER IGNITION SERVICE.

In a word, SPLITDORF IGNITION SERVICE is giving the user what he wants, when he wants it.

SPLITDORF ELECTRICAL COMPANY, Newark, N. J., U.S.A.

SUMTER Low-Tension Magnetos for Stationary Engines

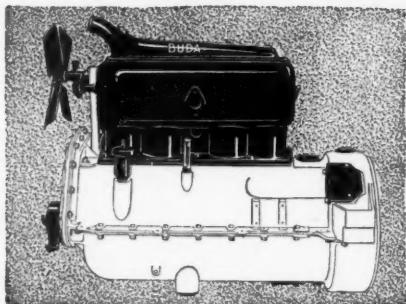


SUMTER PLUG OSCILLATORS SIMPLIFY ENGINES for the FARMER

THE SUMTER line of low tension magnetos is not only prominent in the marine world but in the stationary engine field for the thousand and one utilitarian purposes to which gas engines are universally applied.

THE SUMTER Plug Oscillator is used on the small and medium-sized farm engines in place of the rotary low-tension magneto and make-and-break igniter. It permits easy starting of engines of practically any size, the hot intensity of the spark being independent of the rotating speed of the engine. It is a unit in itself—as replaceable as a spark plug.

“LET US HAVE THE FACTS”—No. 7



TESTS

“Quantity production” always seriously threatens quality, for it is based on the effort to *meet a price*. It cannot allow for tests thorough enough to *really prove* that the quality aimed at in the construction of the motor has actually been attained. Until such *real tests* have been successfully passed, any motor is of problematical value *regardless of price*.

The BUDA MOTOR

has its performance assured by a system of inspection and tests unequalled, as far as we know, in the field of commercial motors. *Every BUDA MOTOR* must pass individual part tests, partial assembly tests, entire assembly (belt and then power) tests, after which *it is entirely dismantled* and readjusted. It is then reassembled and given a conclusive dynamometer test.

You are assured to the limit of practical possibility of the full rated power and perfect running condition of every BUDA MOTOR which leaves our factory. This *means something to you* when the motor is put “on the job.”

THE BUDA COMPANY, HARVEY (Chicago Suburb) ILL.





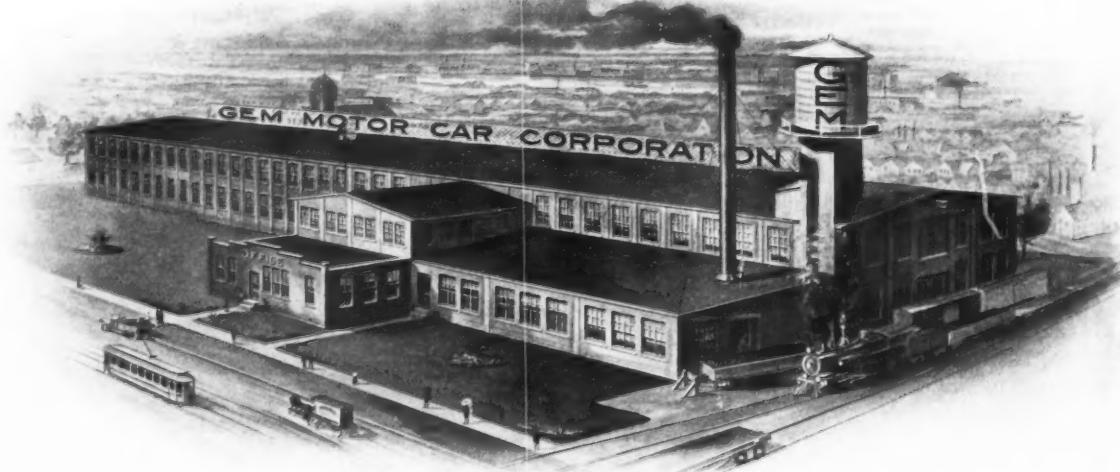
FROM Grand Rapids it is easy to get GEM Motor Cars. Built in Grand Rapids—sold everywhere. Strategically located to raw material markets, reducing production cost to a minimum, and consequently reducing list prices appreciably. Plus value—low prices, quality considered, sell GEM Cars.

GEM Is Located In Grand Rapids, Michigan For Dealer Service

Dealer co-operation makes representatives of GEM Motor Cars practically members of the firm. Low prices make the line a winner. Grand Rapids woodwork with the famous Grand Rapids finish make GEM the best appearing commercial and passenger cars in their class. Sturdily built throughout, they are dependable in any service.

The entire GEM organization is built on dealer service. Write for complete details and free illustrated catalog of all the GEM designs.

**Gem Motor Car Corporation
Grand Rapids Michigan**



Please mention The Automobile when writing to Advertisers

GASOLINE TANKS MADE TO YOUR SPECIFICATIONS



Steel Welded Tank

Terne Plate Built-Up Tank

Welded or lock-seamed, all types and sizes, furnished in any quantity and prompt delivery assured.

Our special tank department, equipped with modern machines, manned by highly-skilled workmen, offers exceptional facilities for serving you.

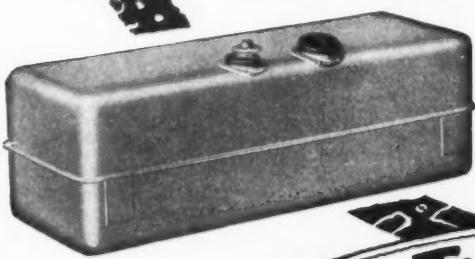
G.P.&F. SERVICE
"KNOWING HOW SINCE '81"

not only gives you the advantage of this specialization, but in addition the benefits of the experience of our large organization, with 36 years to our credit in the manufacture of pressed steel parts.

Many automobile manufacturers are profiting through G. P. & F. specialized service in furnishing gasoline tanks. Let us show you what this service can mean to you.

Send us blue-print or sample for estimate.

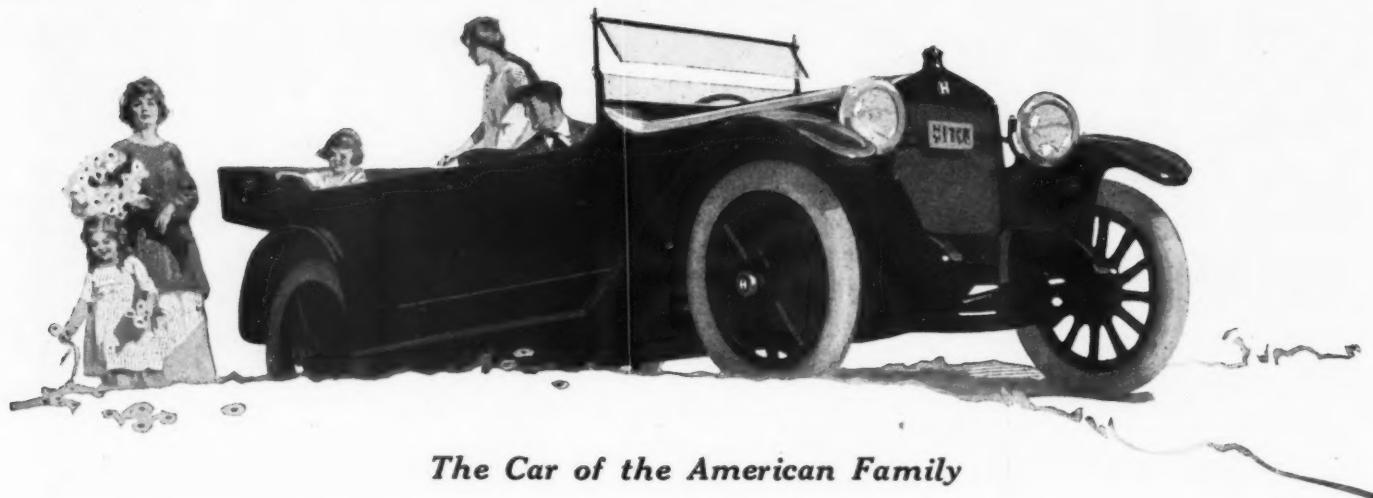
Geuder, Paeschke & Frey Co., ¹⁴²²⁻¹⁷⁰⁰ St. Paul Ave. Milwaukee, Wis.



Drawn Steel Lock-Seamed Gas Tank

Drawn Steel Lock-Seamed Gas Tank





The Car of the American Family

A National Reputation Made International

We believe the Hupmobile to be the best car of its class in the world.

Evidence of an extraordinary sort supports this conviction.

The work it is doing the world over is nothing short of wonderful.

In Bombay, India, it has been given semi-official recognition.

Hupmobiles Kept; Other Cars Sold

No other car will be used there, hereafter, by the British government.

At the end of the campaign in German East Africa, the British government sold at auction all the surplus motor cars in its possession.

These cars had been used in its war operations.

The government ordered, however, that all its Hupmobiles should be retained in service; and has since ordered several hundred more Hupmobiles for military use.

Border Performance Called Remarkable

On our own border, reports of Hupmobile performance are so remarkable that, for military reasons, propriety forbids their publication.

In the mountains of Mexico, Hupmobiles owned by the rebel chieftain Villa have borne the brunt of his road operations. His representatives have sought, and been refused, two hundred Hupmobiles to be used as the backbone of their army transport system.

War Work Shows Greater Value

These evidences of rugged fitness for war work are merely sidelights, which make the *Greater* value of the Hupmobile stand out in bold relief.

That greater value is in the service of the home.

Not without reason has the Hupmobile been called the car of the American family.

It is the car of cars for the domestic circle seeking service free from excessive cost.

Re-Sale Value Very High

It is economical because of its simple four-cylinder construction, standardized by years of progression.

It is rugged; it is superlatively smooth; and it is astonishingly swift in pick-up.

It asks no odds on any point of performance, from any multi-cylinder car it may meet in competition.

It has a very high re-sale value.

Safe, Sound, Sure Investment

From every angle, it is not only a most excellent and efficient motor car—but a safe, a sure, and a sound investment.

To repeat—now, more than ever, we believe the Hupmobile to be the best car of its class in the world.

Hupp Motor Car Corporation
Detroit, Michigan

Year-Ahead Beauty Features

Over and above its reputation for ruggedness, the new Hupmobile has won recognition, as the year-ahead beauty-car. The following are typical of its 25 new style features:—

Bright finish, long grain, French seam upholstery

Improved cushions and lace type back springs in seats

Leather-covered molding finish along edges of upholstery

Neverleak top, black outside, tan inside—waterproof

Tonneau gipsy quarter curtains, integral with top

Front and rear edges of top finished with leather-covered molding

Hupmobile-Bishop door-curtain carriers, folding with curtains—exclusive

Bright leather hand grip-pads on doors

Large door pockets with special weighted flaps

Body a new color—Hupmobile blue

New variable dimming device, graduates brilliancy of headlights

New soft operating clutch

Four Models—Two Chassis

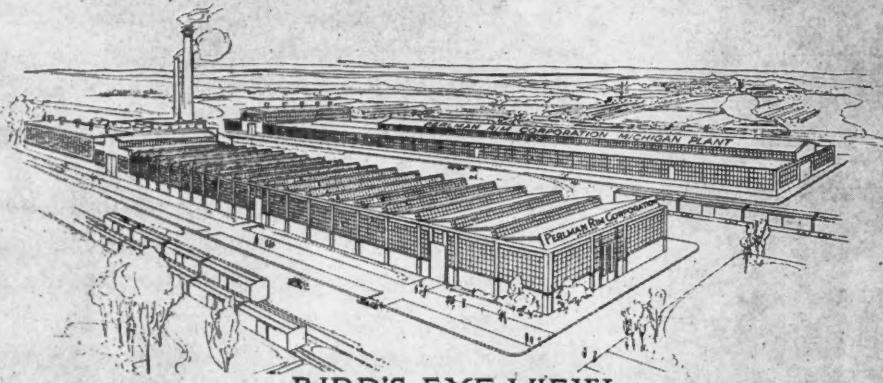
Five-passenger Touring Car, Roadster, Sedan — 119-inch wheelbase; seven-passenger

Touring Car — 134-inch wheelbase.



The New Hupmobile

Where Perlman



BIRD'S EYE VIEW
of the
PERLMAN RIM CORPORATION
JACKSON, MICHIGAN, PLANT

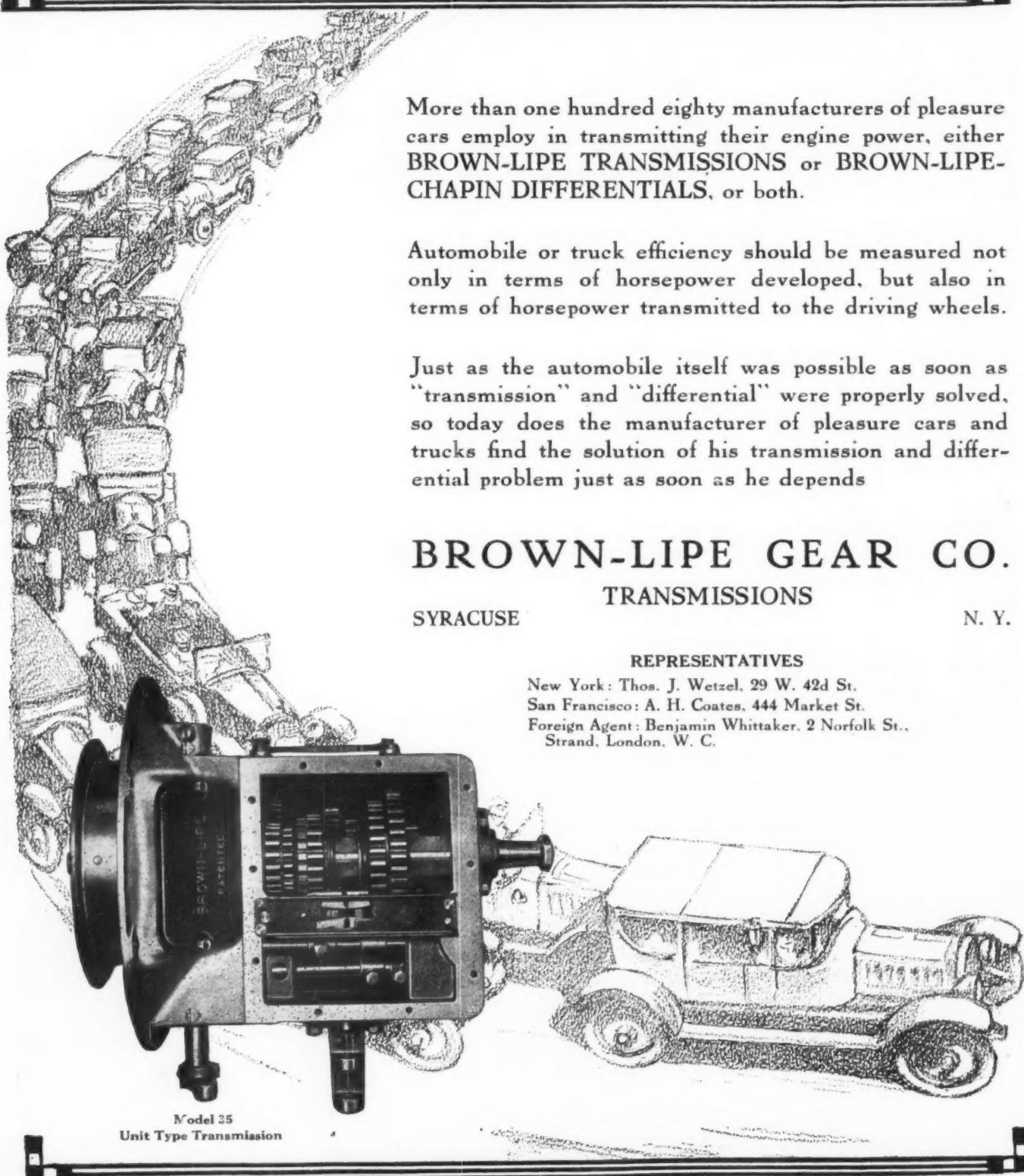
Demountable
Rims are made

The largest and only exclusive demountable rim plant in the world, covering five acres. The mechanical equipment is new and up to date, ensuring volume and quality production. Producing five thousand sets of demountable rims every working day. Enough to equip over one million, five hundred thousand (1,500,000) motor cars annually. Prompt shipments of demountable rims in any desired size and quantity. Perlman S. A. E. Bands and S. A. E. Steel Rims—Are U. S. Army 1½ and 3-Ton Military Truck Standards—For S. A. E. Demountable Solid Tires—Single and Double.

We solicit your demountable rim business, inviting correspondence.

PERLMAN RIM CORPORATION

BROWN-LIPE TRANSMISSIONS



BROWN-LIPE-CHAPIN

DIFFERENTIALS

upon BROWN-LIPE GEAR CO. and BROWN-LIPE-CHAPIN CO. products.

These names are as old as the industry. These products are as dependable as the industry.

Dealers and owners know a car or truck is worthy if it has these products.

Particulars about design, material, heat treatment and workmanship furnished on request.

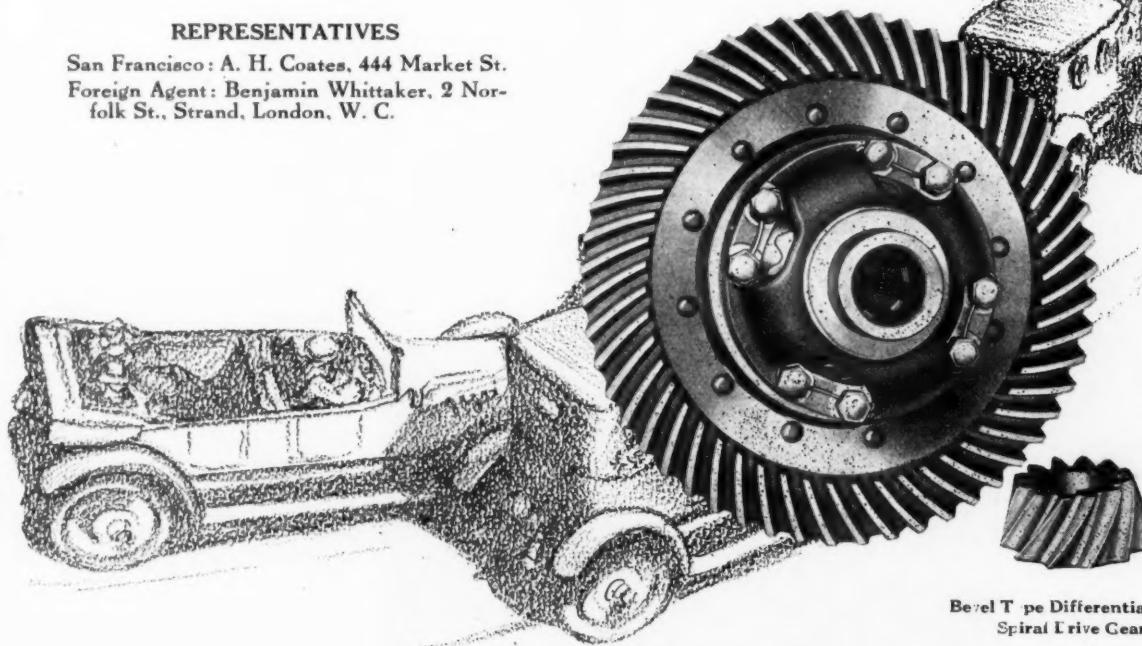
BROWN - LIPE - CHAPIN CO. DIFFERENTIALS

SYRACUSE

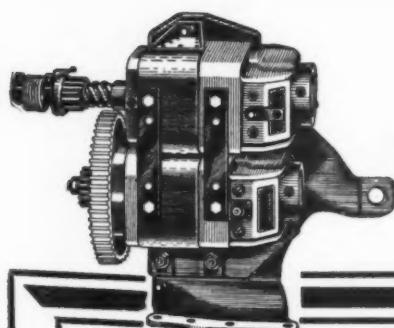
N. Y.

REPRESENTATIVES

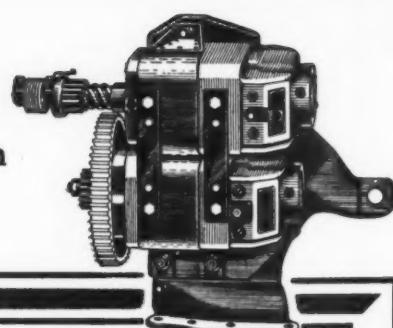
San Francisco: A. H. Coates, 444 Market St.
Foreign Agent: Benjamin Whittaker, 2 Norfolk St., Strand, London, W. C.



Bevel Type Differential with
Spiral Drive Gears



System Complete \$85 f.o.b. Boston

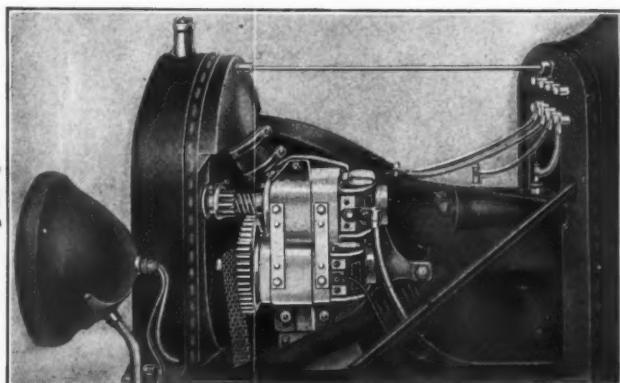


GRAY & DAVIS STARTER for FORD cars

The dependability of Gray & Davis system increases the demand for the Ford. No engine too stiff—abundant power—steady light running or standing. The simplicity of design assures permanent reliability. Dynamo is regulated by means of a third brush. Battery keeps fully charged. The starting motor operates automatically. Nothing to get out of order.

GRAY & DAVIS, Inc., Boston, Mass.

Canada—Universal Car Agency, Windsor, Ont.



WORTH MORE

DOES MORE

The LOCOMOBILE
deserves the
Berling Magneto

IN the pleasure-car field, there is no more conscientiously constructed car than is the Locomobile. The Locomobile deserves the Berling and has adopted it, after two years of almost continuous test.

The reasons are myriad; here are a few:—

The Berling's spark

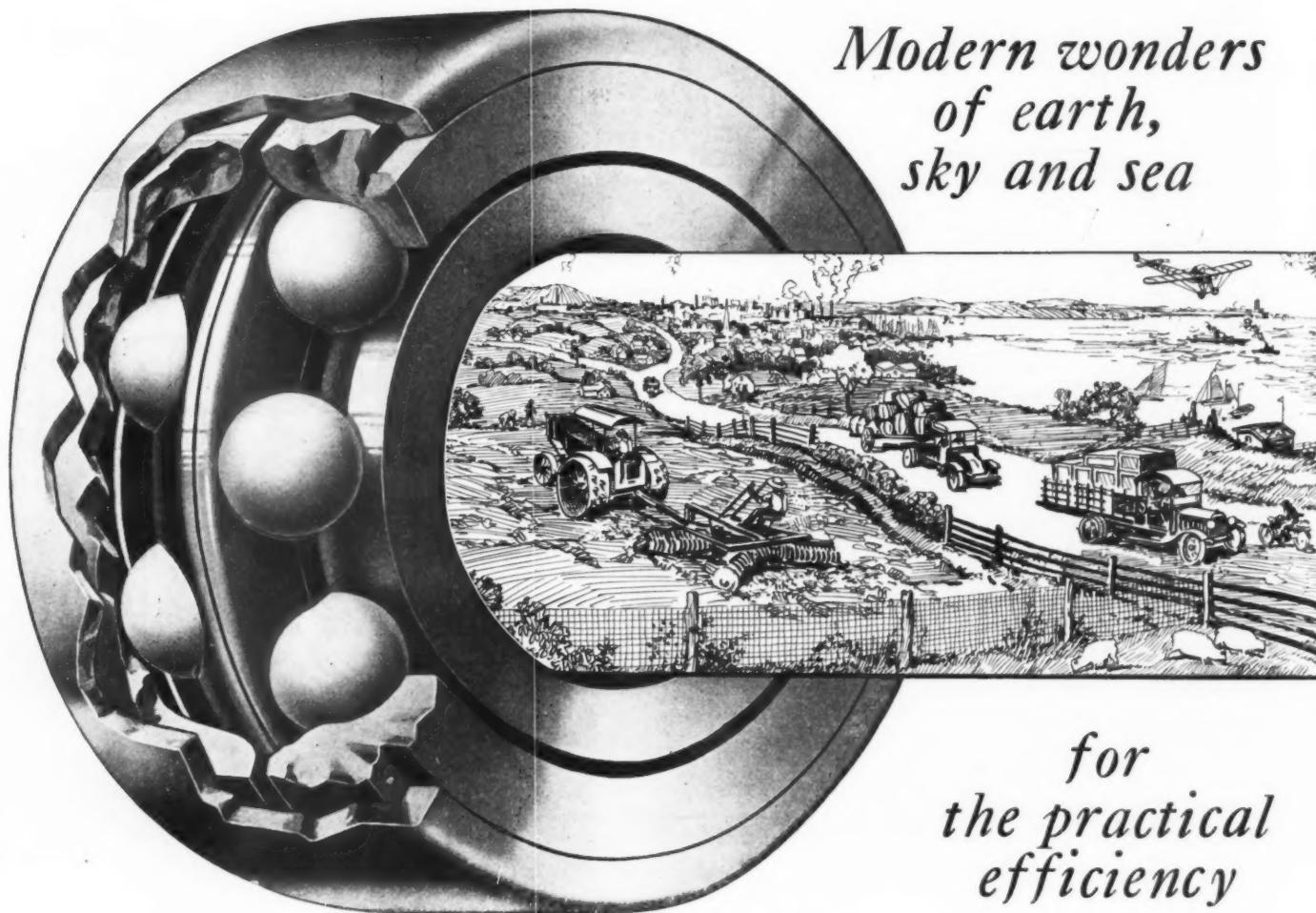
meets the demands of the most stringent and skeptical of engineering tests. The Berling's spark is not only hot and fat, but is constant—and adequate at all speeds.

You may profit by the years-long tests of the great engineers. Let the Berling insure your motors against ignition trouble.

Ericsson Manufacturing Company
1110 Military Road, Buffalo, N. Y.

NEW DEPARTURE

*Modern wonders
of earth,
sky and sea*



*for
the practical
efficiency*

ENGINEERING skill and the science of mechanics have combined in New Departure Ball Bearings an agent for fighting the ancient evils of friction so that it has been eliminated almost to the total vanishing point.

None of the world's finest products are more highly refined in special materials that are basic of quality; none are more perfectly designed for correct performance.

Write for a set of New Departure Engineering Bulletins with binder—the most remarkable and comprehensive data book on ball bearings for the automotive world. It covers, with drawings and explanations, the most modern installations in every part of the automobile, aeroplane, truck, tractor and motor boat.

THE NEW DEPARTURE MANUFACTURING COMPANY,

Conrad Patent

Please mention The Automobile when writing to Advertisers

BALL BEARINGS

*depend upon ball
bearings to no
small degree*



*of their
very great service
to man*



NONE are more carefully manufactured and assured by persistent checkings; none are more successful in accomplishing this work purposed—than are New Departure Ball Bearings.

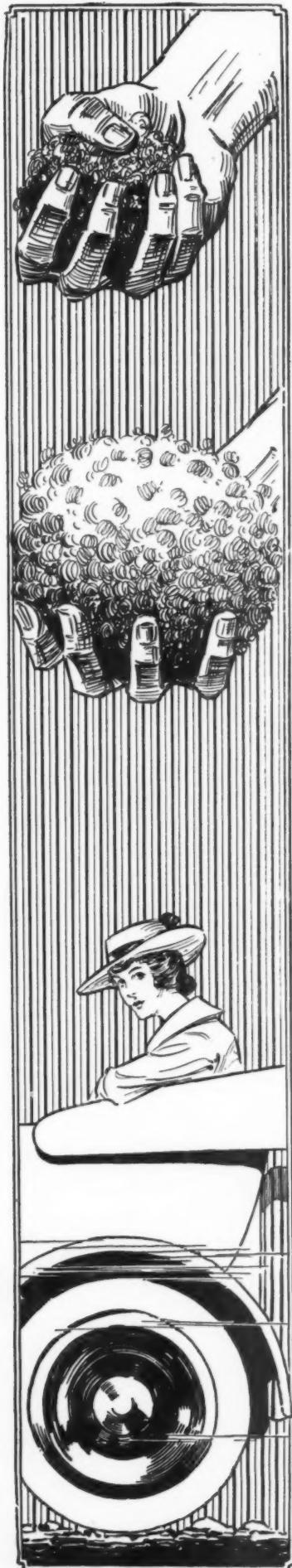
Whether New Departures are in your automobile, truck, tractor, motor boat or doing the heavier work of battleships and huge machinery, they are giants of strength and conquerors of friction *that pay in both money and money's worth.*

We also offer "Ball Bearings in Commercial Applications," which shows by photographs over 125 actual installations in heavy duty service in well known commercial vehicles, tractors and industrial trucks.

We invite you to command the services of our staff of engineers at Bristol or Detroit in effecting the solution of any problems you may have.

BRISTOL
Licensee

FORD BUILDING, DETROIT



Steel Springs vs. Curled Hair

CURLED Hair is accepted as the most successful and satisfactory filler for good furniture and vehicle upholstery, because it *absorbs* a shock —oozes it into nothingness, causing impact to lose imperceptibly

The thousands of tiny spirals in a handful of Wilson's Curled Hair point in all directions, affording a resiliency that is practically everlasting.

There is a vast difference between the action of Curled Hair and that of metallic springs under impact. Curled Hair yields from all sides; coiled springs move downward and upward only.

In good upholstery Curled Hair is essential. It never has been and never can be successfully supplanted. It is a requirement that people who buy furniture and automobiles are considering.

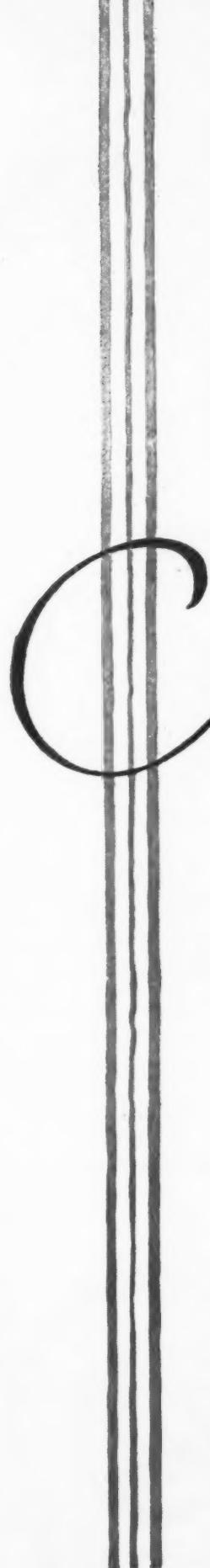
Write for our booklet explaining the Wilson method of preparing Curled Hair.



41st St. and Ashland Ave
CHICAGO

Please mention The Automobile when writing to Advertisers



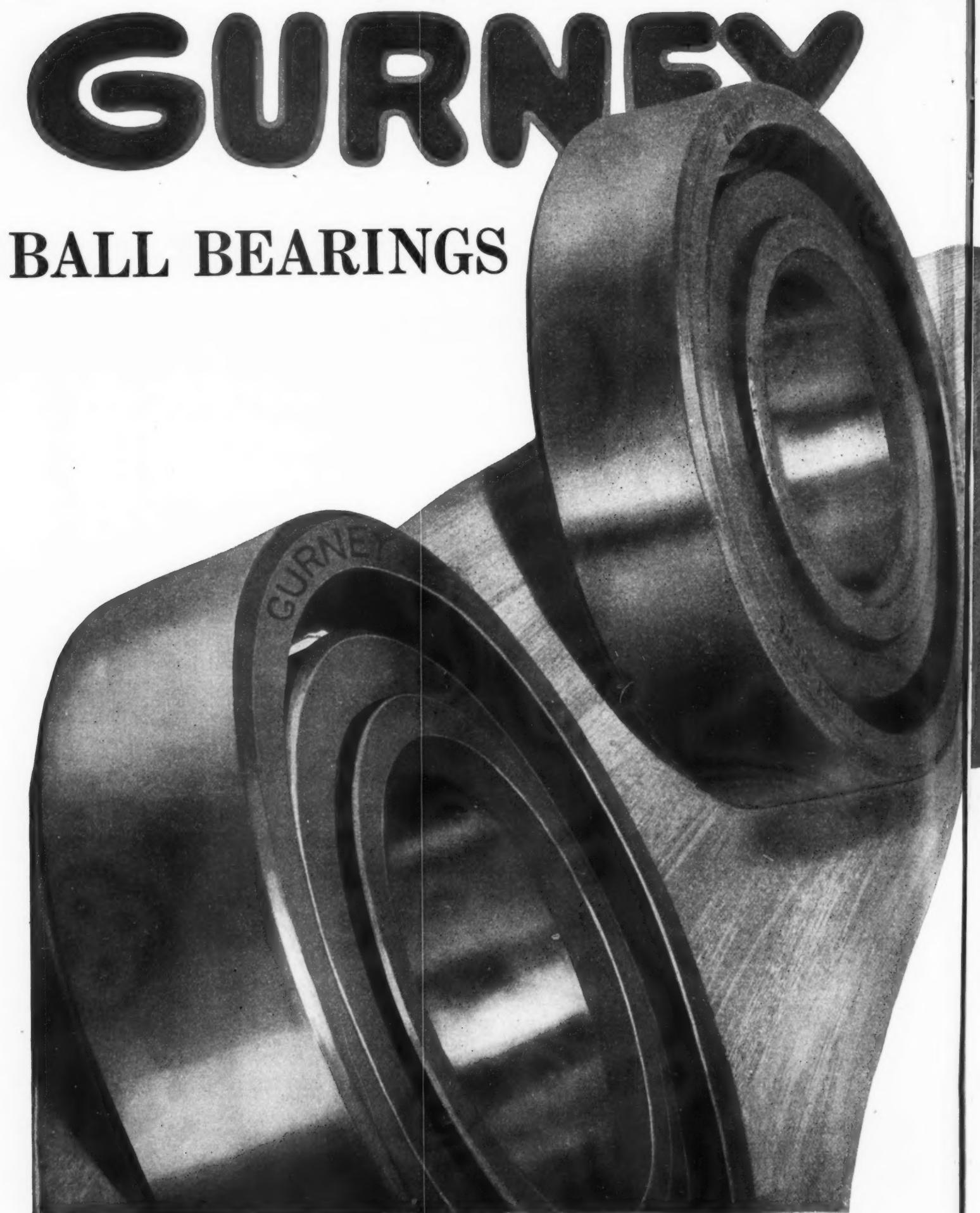


There are good
dealers in towns of
25,000 population
who with this line
have the chance to
become *big distributors*
in towns of over 100,000.
Possibly you may be
hiding your light under
a bushel.

See announcement next week



For advance information wire or write
MOTOR AGE, 95 West Fort St., Detroit,
Michigan. Inquiries marked "Confiden-
tial" will be answered direct by MOTOR
AGE, and so treated.



Please mention The Automobile when writing to Advertisers



Three Outstanding Features

The use of special machinery developed by Mr. Gurney insures the highest degree of accuracy in the **contour of raceways**. They give GURNEY BALL BEARINGS their remarkable load capacities. It is an established fact that one ball in the GURNEY raceway will carry as much load as twenty-six balls would carry on a flat surface.

The design of GURNEY BALL BEARINGS permits the assembly of more balls and larger balls in a continuous raceway (no filling slot is used). These larger balls and more of them, with perfect raceways, insure that much more load-carrying capacity.

The design of GURNEY BALL BEARINGS insures a radio-thrust bearing of exceptional efficiency.

Our series of Bulletins covers different Bearing requirements. In writing, please use business letterhead and state your requirements.



GURNEY BALL BEARING CO.
CONRAD PATENT LICENSEE
JAMESTOWN, N. Y.

CHICAGO



NEW YORK

Ball Bearings

Please mention The Automobile when writing to Advertisers

GASKETS

Copper, Rubber, Steel, Brass, Lead, Asbestos, Paper, Fibre, Copper Asbestos Filled, Leather, Monel Metal, Bronze, Tin, Zinc, Felt, Canvas, Wood, Cork

We have been making gaskets for Automobile Engines since the beginning of the industry, and have made an intensive study of the scientific design and proper construction of gaskets for the different places they are used in the internal combustion engine. We attribute our success and established standing with the trade to the fact that we have always maintained a high standard of quality for all our products.

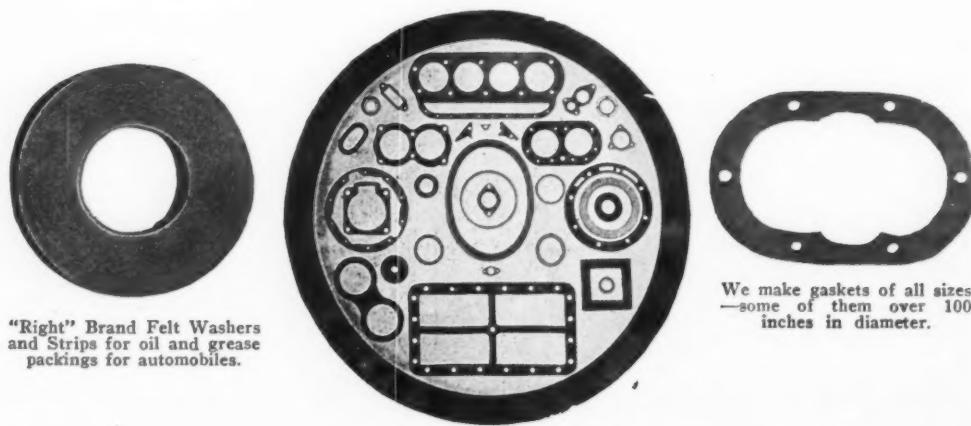
"Right" Gaskets today are used extensively by virtually all the leading pleasure car, truck and engine manufacturers as well as by the leading man-

ufacturers of tractors, marine engines, gas engines, stationary engines, farm lighting plants, etc.

Below is shown some of the different shapes we make, although we are equipped to handle any size gaskets of any shape, made of any material you may wish, with an early shipping date.

Our modern equipment and extensive experience enable us to produce all types of gaskets, of either stock or special design, in large quantities, on short notice. Quotations given on request.

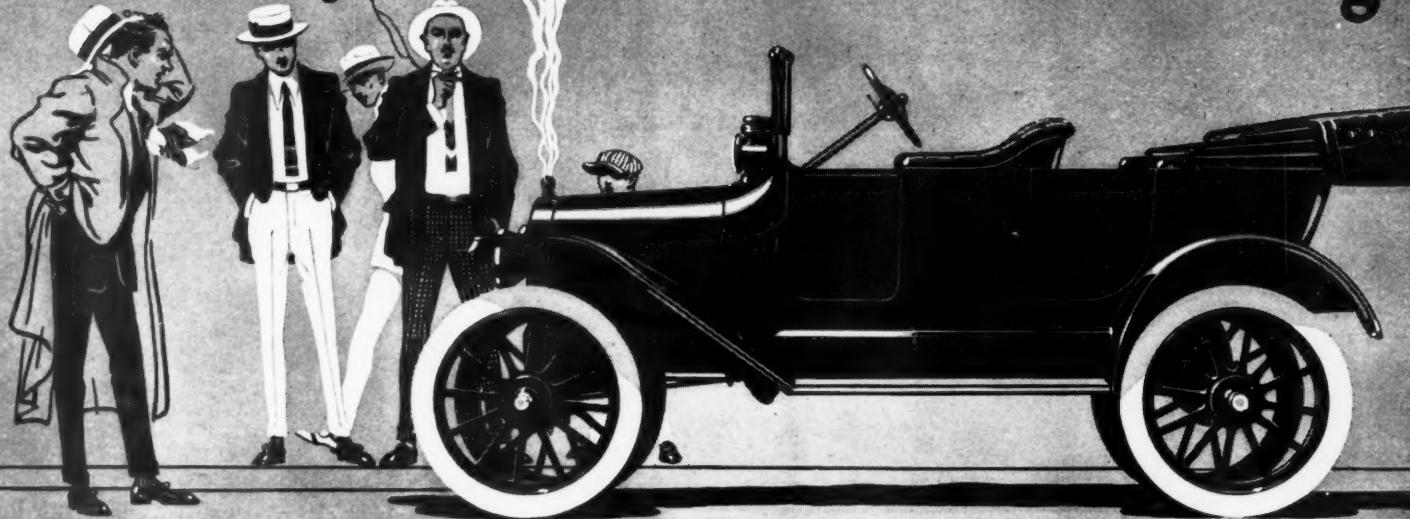
We are also manufacturers of Shims and Pressed Steel Parts



THE GASKET SUPPLY COMPANY
Established in 1894
1722 LUDLOW ST.

PHILADELPHIA, PA.

We positively Guarantee to stop your FORD from "boiling"



A motor that over-heats—

- means great loss of power due to low induction.
- motor burns out.
- pistons "freeze."
- burns out lubrication.
- finally, a ruined motor.

A motor that is over-cooled—

- means excessive waste of gas.
- motor always working 'way under efficiency.
- excessive carbon in cylinders.
- great loss of power due to heat loss to water.
- ruinous to oiling system because gasoline gets down into crank case.

\$337,000 worth sold in last 60 days

Our Distributor at Kansas City says: "I anticipate selling 7500 circulators in my territory, in addition to the 2500 I have contracted for."

And so it goes all over the country, because the Perfection Water Circulator is a **necessity**.

One Ford owner writes: "You will save me from

hell sure if it will keep my "Henry" from boiling and running out of water."

A garage in Arizona writes: "There's not a Ford around this desert that doesn't boil nearly every day and we'd like to demonstrate something that will keep them cool."

Perfection Water Circulator

A remarkable test—

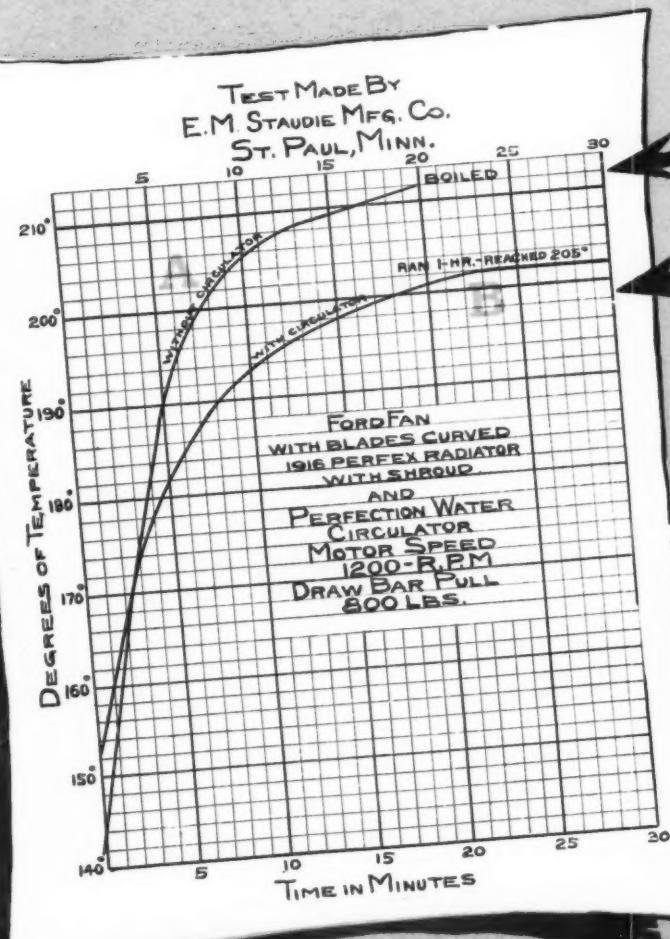
A Ford car, equipped with a Perfection Water Circulator, and a thermometer, was tested in a closed garage. The thermometer showed a temperature of the water in the water jackets of 190 degrees. The spark was then FULLY RETARDED and the motor run at 1200 r.p.m. for 30 MINUTES. At this point the exhaust manifold got RED HOT, which means around 1500 degrees, and no better evidence could there be that there was excessive heat being generated in the motor. But during this time, and in spite of the tremendous heat being generated, the temperature of the water dropped from 190 to 160 degrees. This was because of the increased flow of water which the Perfection Circulator produced, and which takes place just as soon as a heavy "load" is put on the motor. It wasn't a question of the Ford radiator not being large enough, but only a matter of carrying or forcing the heated water to the cooling surface fast enough.



Now ready for FORDS, and soon for all makes of thermo-syphon cooled cars



Tractor Attachment Makers say it has solved their "over-heating" troubles —



Report of Test made at Atlantic, Iowa, May, 1917

"This car is pulling two 14-inch plows, and runs all day and has been since I have been here, from the 16th to the 19th.

"We start early in the morning and plow up until

extra radiator and special fan
yet it boiled in 20 minutes.

— but when they put on the Perfection Circulator they plowed for 17 consecutive hours and it didn't boil.

9:00 o'clock at night. Since the Circulator has been installed and fan, the water has not boiled once. By taking the temperature with a thermometer directly in the water at the top of the radiator, the temperature has not exceeded 208 degrees. We do not use more than one gallon of water in the 17 hours' running, which we do every day. The temperature has been 90 degrees.

"I went down the county about 18 miles today to install a Perfection Circulator on a tractor that the owner has been raising hell about over-heating, and heard from another tractor owner that his trouble has been overcome since the Circulator was installed, so he telephoned for a Circulator to be put on his right away.

"The agent of another Tractor happened to see this test of the Staude Tractor, and tells me that unless his company furnishes the Circulator on his tractors, after he has seen what it means to the cooling, that he will throw over his contract for 5000 attachments."

Now Standard
Equipment on

Staude Mak-a-Tractor
Knickerbocker Forma-Tractor
Western Canada Auto-Tractor

Perfection Water Circulator

This is
what does
the trick



See what Truck Attachment users say:

"Our first.....Ford Truck would dangerously overheat the engine with a light load of 1500 to 2000 lbs. even on cool days.

"When we had a Perfection Circulator put on, the change was immediate. We now regularly carry heavy loads, as the picture shows, amounting to 3000 lbs. and over and even on the hottest days our engines never overheat, they run sweet and smooth.

"We also note a great saving in gasoline and lubricating oils. We now operate fifteen (15) cars, all of which are equipped with Perfection Circulators and give better satisfaction at a greatly reduced upkeep and operating cost.

"By careful test what we have accomplished and saved with the Perfection Circulators, we would not hesitate to pay Twenty-five Dollars (\$25.00) apiece for them, if we could not secure them for less."

(Signed) J. BOLGIANO & SON

Worth Ten Times Its Price

"Before using your device I was handicapped to no small degree in my express and trucking business, on account of my Ford engine over-heating; and was about to dispose of my truck when your Cooling System was brought to my attention.

"This wonderful invention has increased the efficiency of my motor fully 50%, and if I could not replace it I would not dispose of it for ten times the amount I paid for it."

(Signed) RICHARD M. PALMER

Truck Unit Makers Recommend It

"Our distributor at Indianapolis made complaint regarding the over-heating of the Ford motor recently attached to one of our truck units.

"We immediately diagnosed the case as measles and suggested that he install one of your circulators. We have recently had word from Mr. that the case of measles has been thoroughly cured and the motor has given no further trouble from over-heating.

"We will be glad to recommend your Perfection Circulator to all purchasers of our truck units."

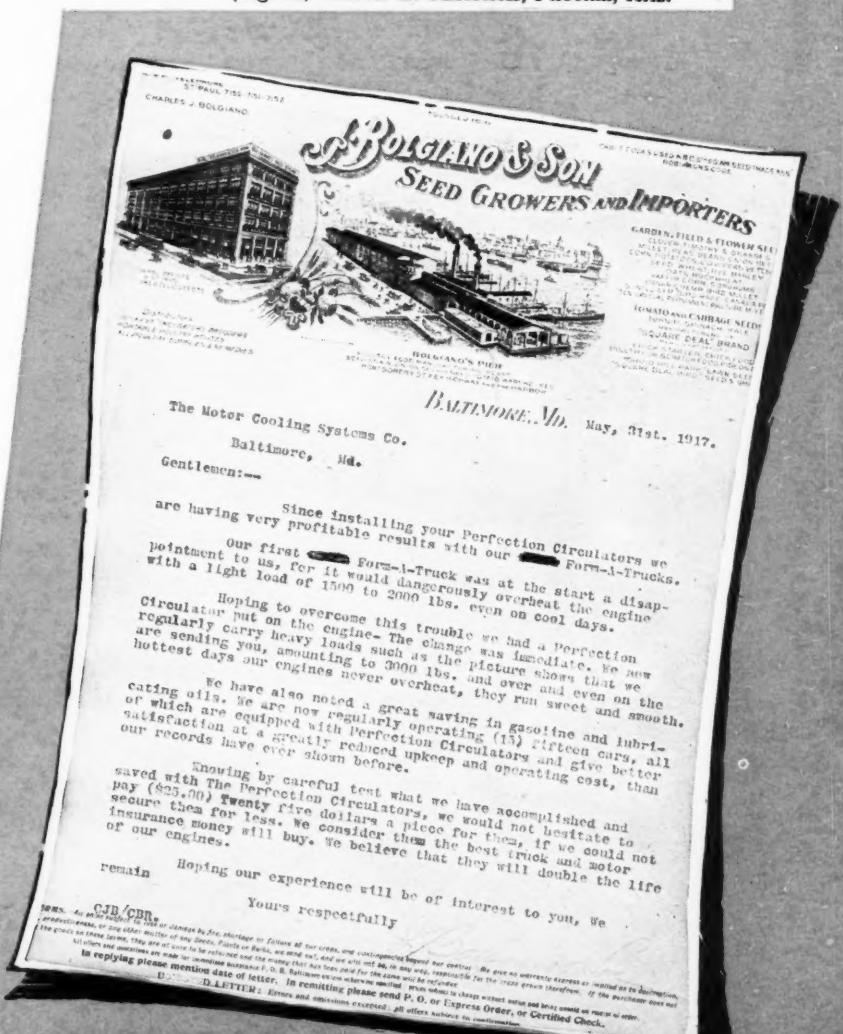
(Name on request)

See "Prize Contest"
on next page —

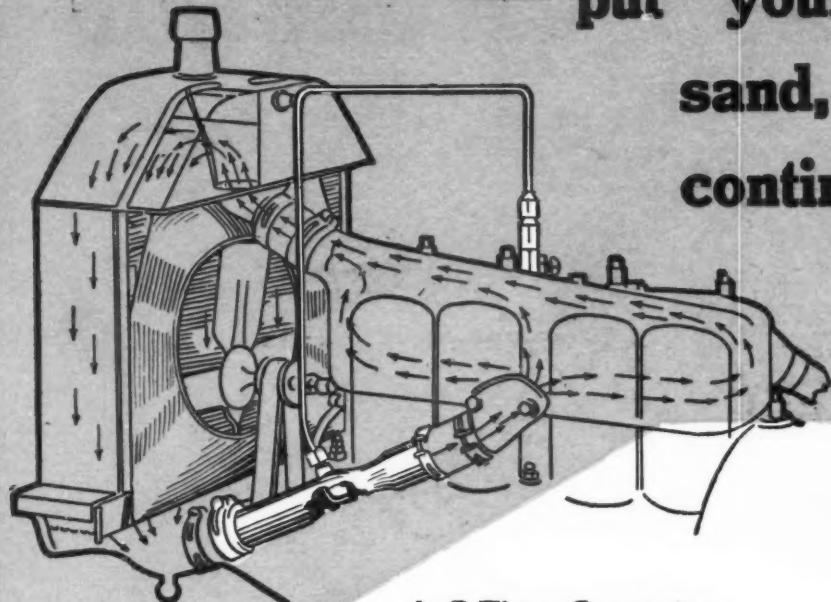
Deep Sand on Desert, Yet Keeps Engine Cool

"I have used it on all kinds of roads and in all kinds of weather, on very deep sand in the desert and on very long steep mountain climbs. It has always kept the engine cool and did not waste the water from over-heating."

(Signed) CHAS. E. CLARKE, Phoenix, Ariz.



— put your **FORD** thru mud,
sand, up steep hills, or
continued running on low
gear, and still we
will **GUARANTEE** it



A 3-Time Guarantee

We absolutely guarantee that when properly installed, you cannot **MAKE** your Ford car boil under running conditions. Even with fan removed it won't overheat. We further absolutely guarantee a saving of gasoline. No test has ever shown less than 9%, and from that up to 45%. We further absolutely guarantee a saving of from $\frac{1}{8}$ to $\frac{1}{2}$ lubricating oil.

Extra long connection tube for cars equipped with electric starters

Perfection Water Circulator

You can put your car through the hardest kind of work—mud, sand, steep hills, continued running on low gear—and still the water in the radiator **will not boil**. Form-a-Tractor and Form-a-Truck owners have solved all their heating troubles by equipping with this system.

Installed in Fifteen Minutes

It takes 15 minutes to install the Perfection Water Circulator. Simply replace the ordinary connection from the radiator to the motor with a similar connection in which is located the Perfection Nozzle; tap the exhaust manifold and connect this to the replaced connecting tube. There are no moving parts—nothing to get out of order or wear out—the Perfection Water Circulator will last as long as the car itself.

30 Days' Trial

If it does not give the most efficient cooling you ever had, send it back; and we will refund entire purchase price. Sent anywhere in United States prepaid. Complete literature sent **FREE**.

\$7⁵⁰

\$3300 in Cash Prizes

\$1000.00 in CASH for merely writing a letter—

We want to know how many car users realize the serious damage that is done to their motor, such as burned-out cylinders, distorted pistons, etc., which practically means a ruined engine—if the car is run when the cooling system is not operating properly. Garage men, automobile and accessory dealers know all these things, but

we want to find how many motor car OWNERS realize how much gas they are wasting, producing excessive carbon with all of its bad effects, together with entirely upsetting their lubrication, when their pump-circulated motor is over-cooled.

Send for particulars of Prize Contest, Entry Blank, and Booklet on what happens to **ANY** motor when the Cooling System fails to work, together with suggestions to contestants that will help them to write their letter and compete for these Cash Prizes.

706 other Cash Prizes

Dealers Wanted We want the best concern in every territory to handle this proposition, as also the other accessories marketed by us. Tremendous sales possibilities, backed by an extensive advertising campaign.

Side Line: Salesmen traveling in Ford cars will find this a most profitable side line.

**Send Coupon
Today**

**Motor
Cooling
Systems Co.**

1317 Conway Building
Chicago, Illinois

Please send me entry blank
in your Prize Contest, also copy
of your booklet, "Motor Cooling
Systems."

Name.....

Address.....

City.....

The Motor Cooling Systems Co.



BAKELITE

Even when design and workmanship are all that can be desired, "quality" parts cannot be produced from material that will not retain quality indefinitely.

High grade electrical parts require "quality" in every particular. The moulded insulation, for instance, must be able to stand up under accidental exposure to heat, to corrosive influences and to shock.

The insulation should be of Bakelite because Bakelite combines just those properties which insure quality under all working conditions. Bakelite could not be so satisfactory and so extensively used for moulded insulation on ignition, starting and lighting apparatus if it did not have abundant heat resistance and strength for the conditions under the hood.

GENERAL BAKELITE COMPANY
2 Rector Street, NEW YORK

SKF

Textile
Machinery

Portable
Tools

Post
Hangers

Power Savings

OFFSET the increasing cost of power by installing S K F Self-Aligning Ball Bearing Hangers. Actual tests made under the hardest conditions have proven that S K F Ball Bearings will make possible a saving of over 33% of the total power used in the plant.

SKF BALL BEARING CO.

HARTFORD
CONN.

PATENTED

Wood-
Working
Machinery

Machine
Tools

Trucks

USED
WORLD

Motor

THE SPIN-OVER

Motor Drives

Shaft Hangers

Grinding Machinery

Blower Fans

Heavy Machinery

Pillow Blocks

Vehicles

SKF

For Every Use

MADE to fit all standard sizes of shafting and are adaptable for almost every type of machine. Our numerous booklets illustrate their use in practically every industry. Send for the ones covering your particular line of business. A request will bring them.

SKF BALL BEARING CO.
HARTFORD
CONN.

Automobile, Tractor, Truck,
Aeroplane, and Motor Boat

ENGINEERS

should be thoroughly conversant with the

JOHNSON CARBURETOR

JOHNSON COMPANY
Makers of Superfine Instruments of Carburetion
DETROIT - - - MICHIGAN



SERVICE

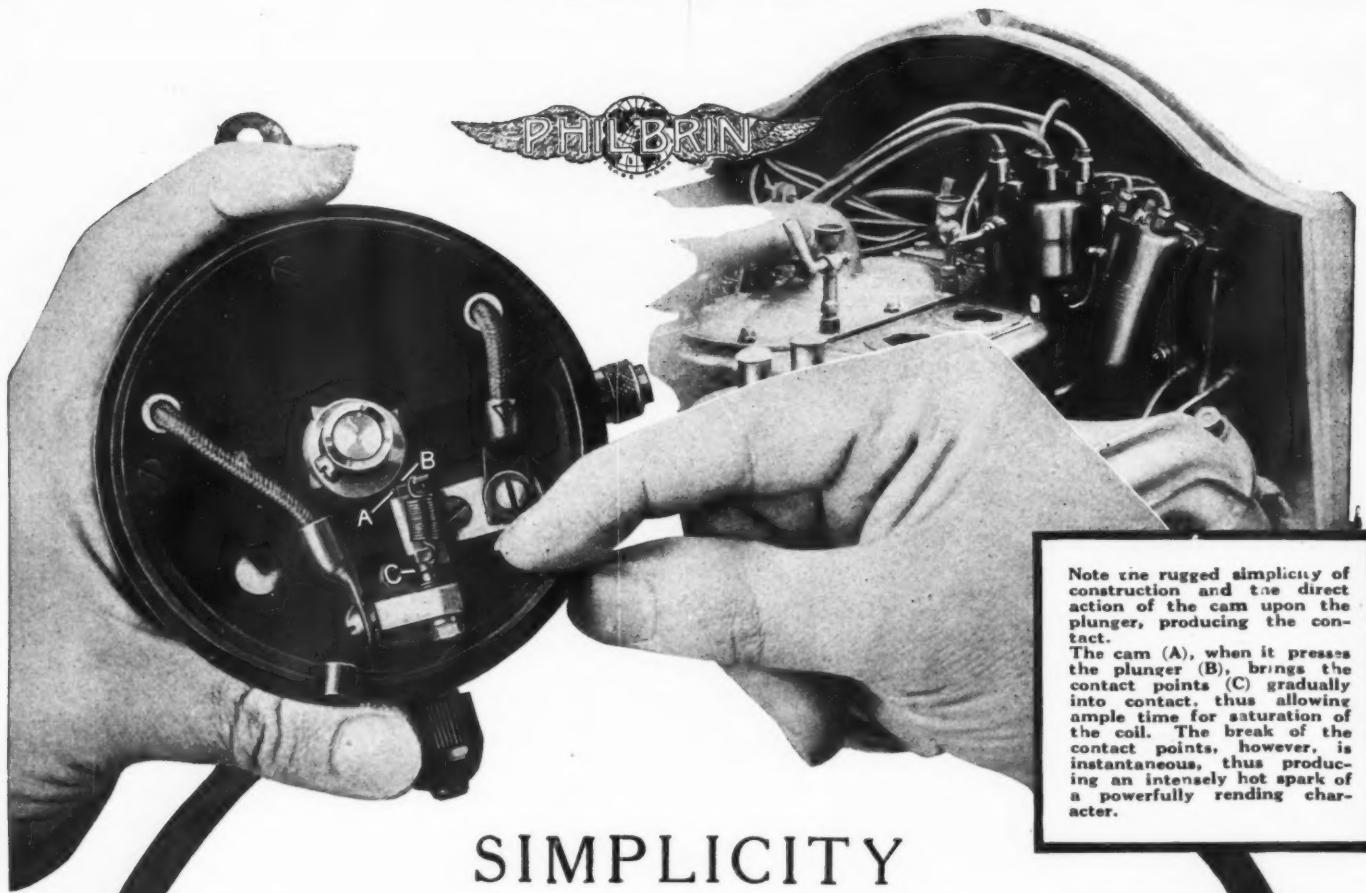
The bearings in the magneto and lighting generator limit the service capacity of your motor car, truck, motorcycle, airplane, motor boat, or tractor. Protect yourself—be **SURE**.

See That Your Electrical Accessories are "NORMA" Equipped.

THE NORMA COMPANY
OF AMERICA
1790 Broadway, New York

NORMA

"NORMA"



SIMPLICITY

The efficiency of any system of ignition lies in its contact maker; in its form of "make and break."

In the PHILBRIN contact maker there is but *one* moving part, exclusive of an adjusting screw.

Such simplicity of construction has many marked advantages. There is practically nothing that can wear or cause trouble. Lag, both electrical or mechanical, is virtually eliminated.

It is easy to understand how *several* moving parts, one dependent upon the action of another, will naturally develop mechanical inertia, especially at high speeds. These parts "lag." They never quite "catch up." Thus the accuracy of firing, called synchronization, becomes faulty.

To achieve snap, pep, power and speed, the ignition must work simultaneously with the motor *at all times*. There must be no "lag."

The PHILBRIN systems *always* give perfectly

synchronized ignition at all speeds. There is no need for a governor.

PHILBRIN Ignition will do this:

Increase your horsepower.

Cut your gasoline consumption.

Utilize lower grades of fuel.

Make starting easy in any weather.

Enable you to operate at extremely slow speeds on high—a big advantage in traffic.

Gives a quick, snappy pick-up, without choking.

And a smoother, quieter running motor.

WRITE for more complete information. We make ignition systems for all makes of cars of any number of cylinders. Easy to install. Moderate in price.

FOR FORD CARS we have a special system of ignition of remarkable efficiency that utilizes the current of the Ford magneto. No battery needed.

DEALERS—Write for selling proposition.

PHILIPS-BRINTON COMPANY
501 S. BROAD ST., KENNETT SQUARE, PA.
Sales Office: 1115 Widener Building, Philadelphia, Pa.

D U P L E X IGNITION SYSTEMS

PHILBRIN

Please mention The Automobile when writing to Advertisers

WOODWORTH

Easyon Chains

—easy to put on

These chains give you fine traction in mud, snow, ice or sand. They are easy to put on even when you are in trouble. They are cheaper, easier to carry, and far more handy than the big chains, and are a constant, certain protection against being stalled for want of traction.

—easy to take off

Easyon Chains are so built that when they cross the tread-center they offer no bumpy, tire-bruising, hard-riding surface. They are also carefully protected against scratching the wheel. They are the simplest, most effective chains you can buy.

—easy to carry

These chains are easy to carry in a car as they take up very little room. And they are easy for a dealer to carry because there are only 3 sizes of them—fitting all cars. Dealers sell them fast and find them great friend-makers.



Trouble Proof TIRES

Guaranteed against puncture or blow-out

Here is a tire that is beyond all question a high quality, lively, resilient, long wearing and easy-running pneumatic shock resister.

A tire that is made of the finest materials in the finest way.

A tire that will run further—weight for weight and speed for speed—than any but its highest-priced competitors.

And—something that even its highest-priced competitors will not do—it will go the full distance without puncture or blow-out.

We guarantee it to do this for 5,000 miles. It actually is doing it—day after day—in actual service—for distances far longer than 5,000 miles.

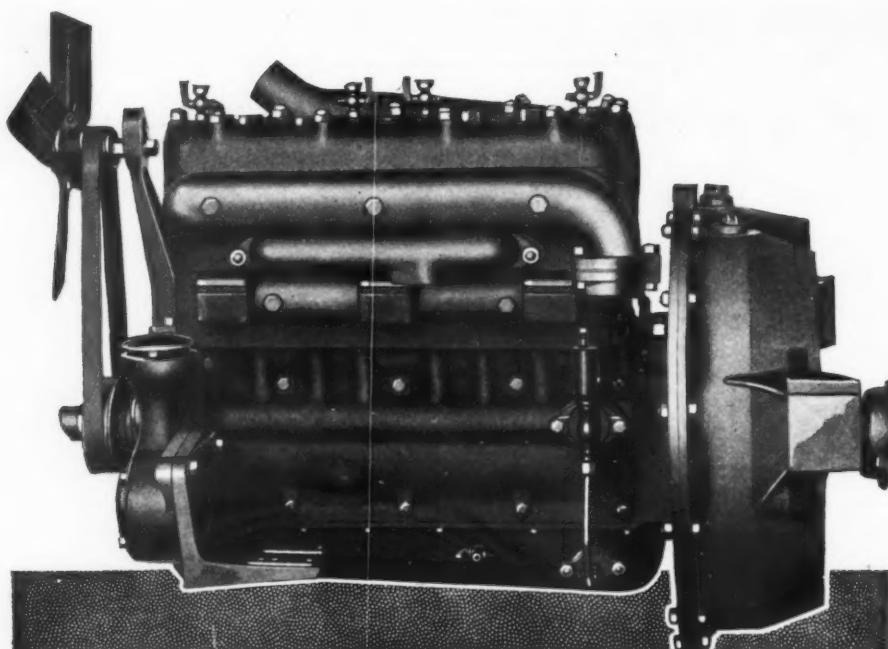
Dealers are selling Woodworth Tires and Easyon Chains to thousands of satisfied customers. Write now for unusually attractive terms.



WOODWORTH MANUFACTURING CORPORATION, Niagara Falls, New York

Canadian Factory: - - - - -

NIAGARA FALLS, ONTARIO



**G.B.&S
motors**

One Model, One Size and One Policy

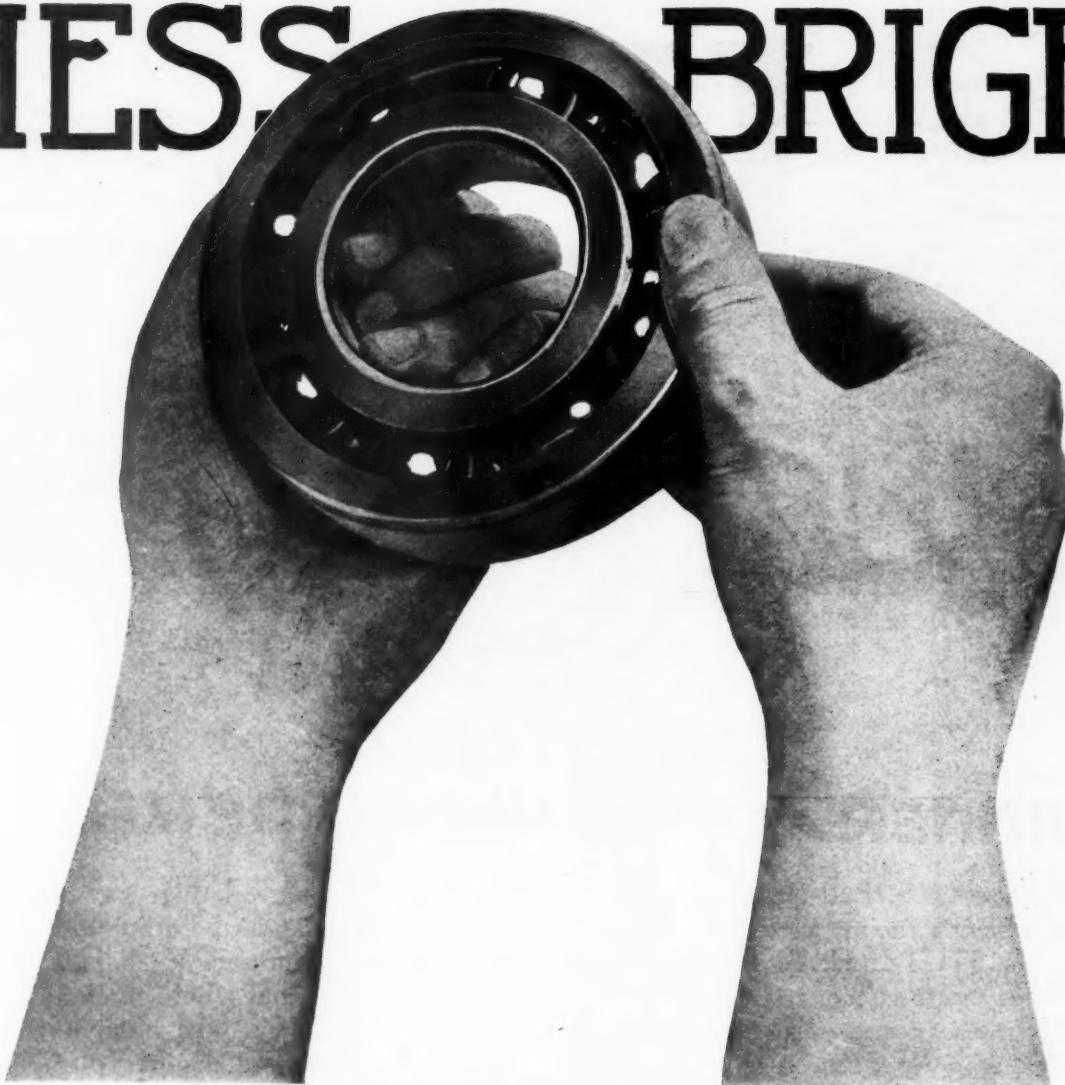
The motor illustrated is the only style "G. B. & S." motor built. This fact is in itself a guarantee and a policy. It explains instantly the why of "G. B. & S." dependability and quality.

Four cylinders, $3\frac{3}{4} \times 4\frac{1}{4}$ in., $22\frac{1}{2}$ h.p. (A. L. A. M.), 36.9 h.p. at 2800 rpm. Adaptable to a variety of transmissions and starting and lighting systems. All "G. B. & S." motors provide for two-unit starting and lighting system only—operating through Bendix drive. Three bearing crankshaft, extra large valves. Combination splash and force feed oiling system. Includes "G. B. & S." Clutch—light operating, positive and easily adjusted.

Write for blue-prints and detailed description.

Golden, Belknap & Swartz Company
Detroit, Michigan

HESS-BRIGHT



Constant Efficiency in Motors

Even if ball bearings did not increase the efficiency of motors their use would be preferable to ring oiler bearings, because they maintain their initial efficiency.

The babbitt bearing wears and efficiency drops with such wear.

The efficiency of a motor equipped with Hess-Bright Ball Bearings remains practically the same after long service, in so far as its bearings are concerned.

The importance of this feature cannot be over-estimated.

**THE HESS-BRIGHT MFG. CO.
PHILADELPHIA**

HESS-BRIGHT'S CONRAD PATENTS ARE THOROUGHLY ADJUDICATED

Please mention The Automobile when writing to Advertisers



U.S. BALL BEARINGS

ON STUTZ
WINNER OF CHICAGO DERBY

Once again have U. S. Ball Bearings participated in an important racing victory. Earl Cooper drove his STUTZ, U. S. Ball Bearing equipped, to victory in the Chicago Derby on Saturday last. In every one of the long list of notable victories won by Stutz cars U. S. Ball

Bearings have played their part, for U. S. Ball Bearings are standard equipment on all Stutz cars, both stock and racing. Just another proof of the statement that where efficiency is the prime consideration, there you always will find ball bearings in dominant degree.

U.S. Ball Bearing Mfg. Co.
(CONRAD PATENT LICENSEE)
Chicago / / / **Illinois**



Announcing the
KIMBALL
NON SKID TIRES

Derby
TreadBar & Button
TreadBar-Grip
TreadCord Type
Tread

KIMBALL **NON** **SKID** **TIRES**

Non-Skid	Tubes	Non-Skid	Tubes		
30x3	\$7.55	\$1.00	35x4	\$17.35	\$3.30
30x3 1/2	9.85	2.15	36x4	17.65	3.35
31x3 1/2	10.30	2.25	34x4 1/2	20.75	4.00
32x3 1/2	11.55	2.35	35x4 1/2	22.65	4.10
34x3 1/2	13.35	2.95	36x4 1/2	23.75	4.15
31x4	14.25	3.05	37x4 1/2	26.60	4.25
32x4	14.75	3.10	36x5	27.20	4.95
33x4	15.75	3.10	37x5	27.00	5.05
34x4	16.35	3.20	37x5	27.00	5.05

Do you want straight side or clincher?

All orders must be accompanied by deposit of at least 25 per cent or no attention will be paid to same. In order to insure quick delivery CASHIER'S DRAFT on Chicago or New York Banks, Express or Money Orders in part or full must accompany order. Allow us first and second choice on our Cord Type, Bar and Button, Derby Tread or Bar Grip tires, in order to receive immediate shipment.

Dept. K, 1469 Michigan Ave.
CHICAGO

Please mention The Automobile when writing to Advertisers



CORNER
the
TIRE BUSINESS
IN YOUR TOWN

The Best Territories Are Being
Snapped Up. Write Quickly.

*Are You the "Live Merchant"
of Your Town?*
ARE YOU PREPARED FOR BIGGER BUSINESS?

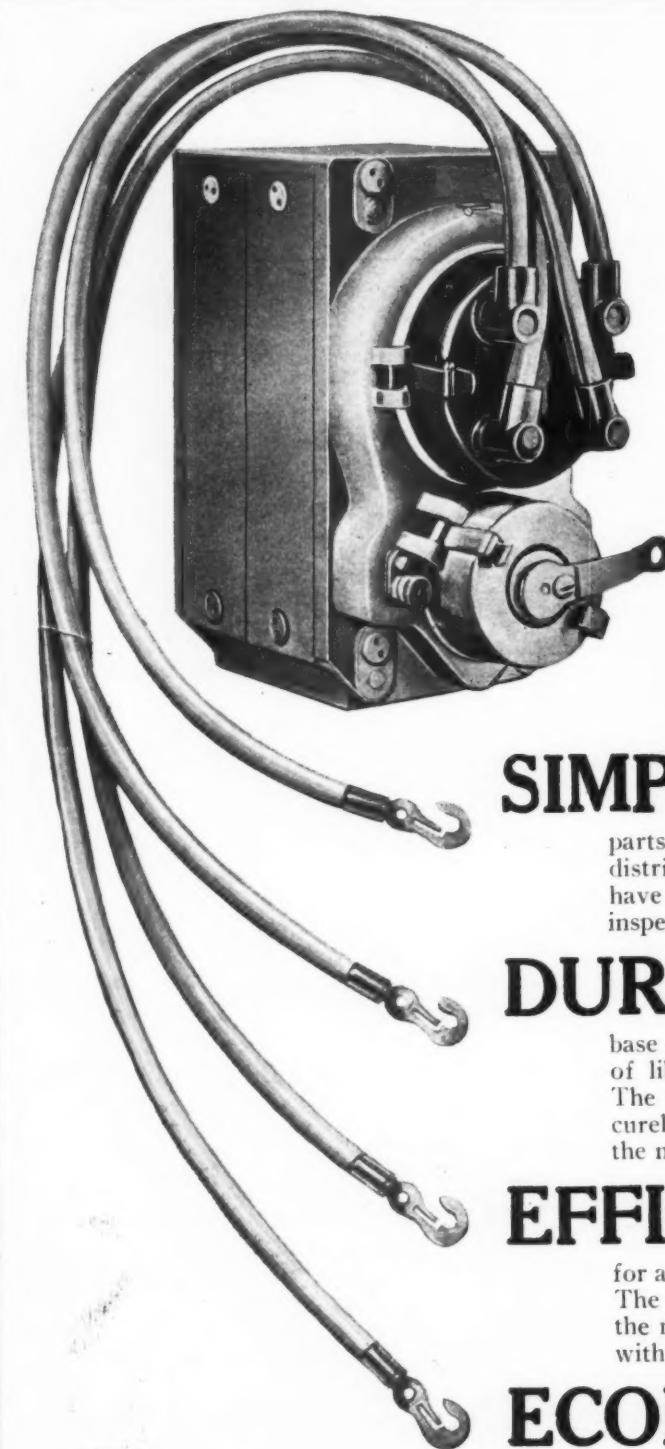
The KIMBALL TIRE agency proposition means CAPITAL and BUSINESS to the wise dealer who gets it in his territory. KIMBALL TIRES cost you about one-half the price of the lowest priced tire manufactured and give every dealer a splendid opportunity to carry on a prosperous cut-rate tire business and also compete with all the mail order houses. The Largest Dealers in the country are taking advantage of this wonderful opportunity to get the KIMBALL TIRE agency. We allow only one dealer in a territory to handle Kimball Tires, and you may rest assured that every automobile owner will soon be purchasing KIMBALL TIRES from him. There is some extremely profitable open territory, offering remarkable opportunity to build up a big, sound and permanent business on KIMBALL TIRES. It will be to your own best interests to write immediately for territory and PREPARE for BIGGER BUSINESS.

Our Guarantee Protects You

Do not hesitate about sending money in advance. WE ARE ABSOLUTELY RESPONSIBLE and GUARANTEE EVERYTHING to be as represented or your money back. As Uncle Sam does not a low fraudulent use of the mails, you are perfectly safe in sending your money in advance. Every Tire that we sell is absolutely guaranteed to be as represented or money refunded, provided the goods are returned to us within five days in the condition in which they were received.



The Kimball
TIRE & RUBBER CO.



The TEAGLE High Tension MAGNETO

—an American achievement

embodying these salient features
of difference and superiority

SIMPLICITY

The stationary coil and condenser are assembled and mounted as a unit. The only rotating parts are the laminated iron rotor, distributor gears and distributor arm. All moving wires, brushes and slip rings have been eliminated. Every part is readily accessible for inspection.

DURABILITY

A construction resulting in great sturdiness is one of the principal factors. The base and top are made of special electrical gray iron castings of liberal sections firmly fixed to the die cast end plates. The straight bar permanent magnets, a unique feature, securely clamped to the sides, give additional support. It is the most sturdy machine on the market.

EFFICIENCY

A hot uniform spark of high initial current value and voltage is produced and sustained for a sufficient length of time to insure complete combustion. The size of the coil is not limited as in other magnetos, with the result that extremely low sparking speeds are obtainable with unexcelled electrical dependability.

ECONOMY

Economical manufacture, with the highest grade of workmanship, is secured due to the simplicity of construction, resulting from the entirely new principle of design. Its first cost is the only cost.

"A better spark in a simpler way"

BUILT EXPRESSLY FOR TRUCK AND TRACTOR SERVICE

Write for booklet and full information



THE TEAGLE COMPANY
CLEVELAND, O.





“TRIPLEXD”
Paint-Spray Hose

This cross section tells you why Triplexd is the only hose that will “stand the racket” of constant use—of heavy paint forced through under pressure—of strong cleaning compounds under heavy pressure to remove all traces of one color before using another—of dragging from place to place around automobile bodies.

If you are still painting your car bodies by hand, investigate the paint-spray method and

“Specify TRIPLEXD”

METAL HOSE & TUBING CO.
INCORPORATED
RAYMOND & TILLARY STS.
BROOKLYN, N.Y.

“TRIPLEXD”
The New Gasoline Hose

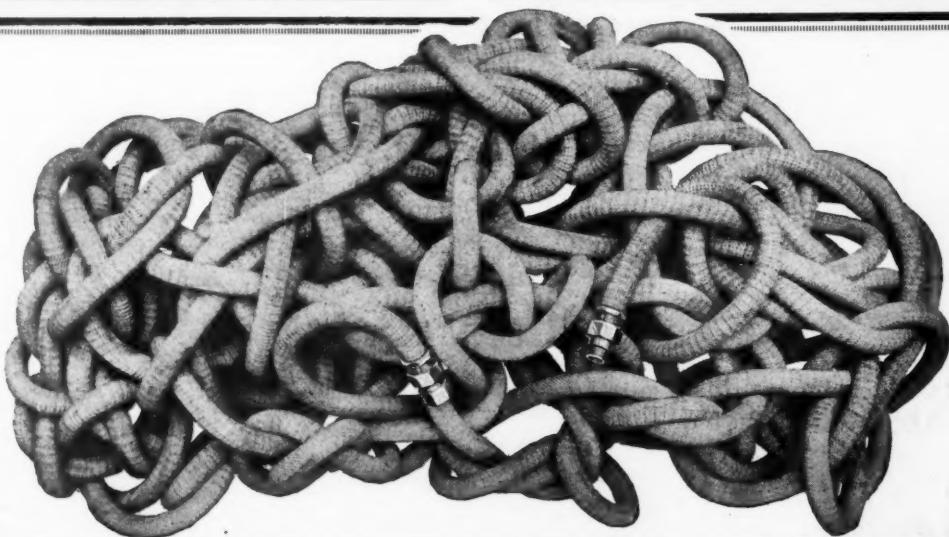
Built for permanent service. Three coats welded into one inseparable unit—an inner coat of flexible metal tubing interlocked with a second coat of special gasoline rubber and the whole bound tightly by the outer coating of strong woven fabric.

Guaranteed for one year's service. In many cases gives two and a half and three years' service.

Whatever use you have for gasoline hose
“Specify TRIPLEXD”

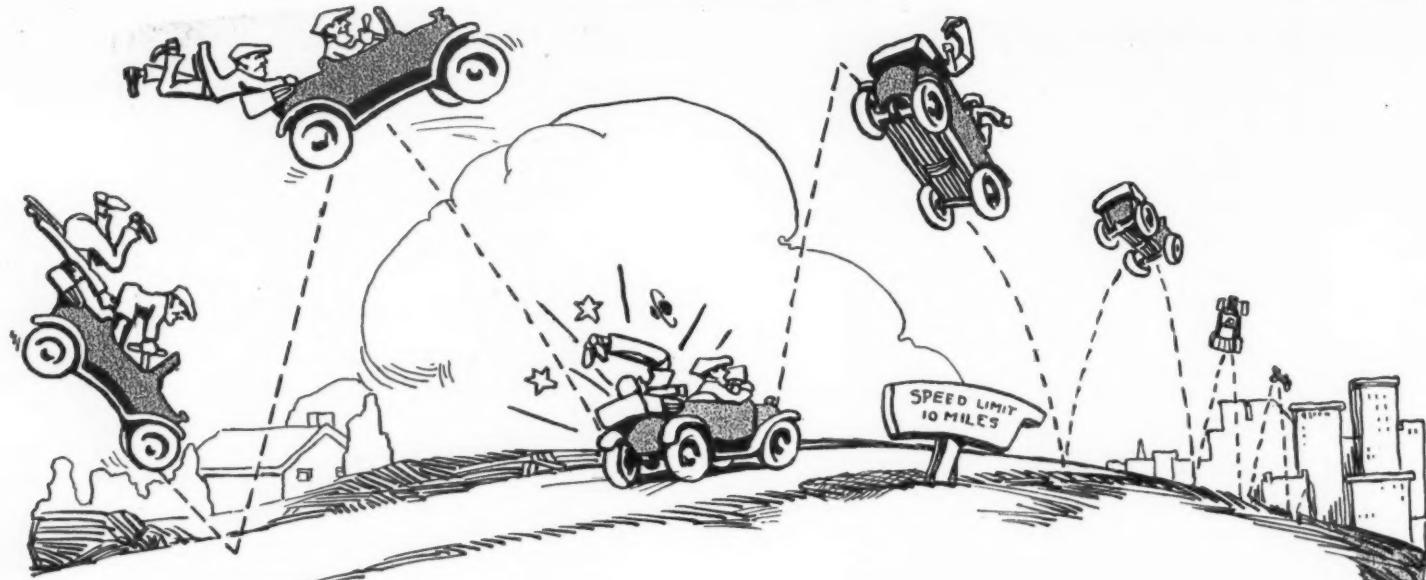
Rugged
Yet
Flexible

Flexible
Yet
Rugged



TRIPLEXD

Please mention The Automobile when writing to Advertisers



"My Friend, Louis, Went 50 Miles an Hour in His Ford Last Week, 25 Straight Ahead and 25 Up and Down."—Gilbert Southwick

Louis broke a record last week—and fractured a windshield. He wanted me to see his car do 50 miles an hour—and he gave me a ring-side seat. He picked a harmless looking road, with a German plot and a belligerent disposition—and when we landed on it once in a while, the sensation was about as soothing as a fall on the ice.

"Going 50," shouted Louis—and we were. Twenty-five straight ahead and 25 up and down.

**Now His Car Rides Smooth and Easy
Equipped with W & C—The Original Double-Arm
Shock Absorbers for Ford Cars**

Louis and I lived through a period of armed neutrality after that ride, until he got a set of W & C Shock Absorbers and mounted them on that boat. Now you wouldn't know it was the same car, and Louis is as tickled as the other 100,000 or more who rely on W & C Shock Absorbers for real comfort in Ford cars. He's planning a long tour for the summer, and short runs nearby for every week-end, for the first time since he owned his car.

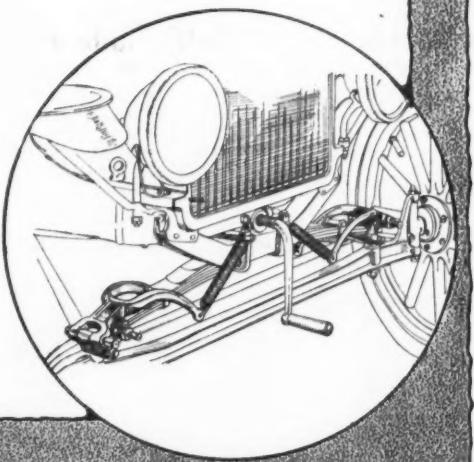
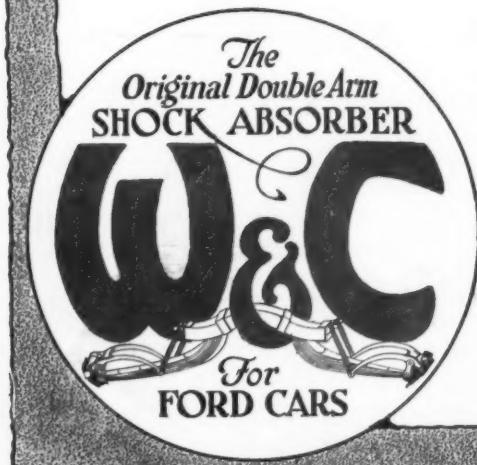
**W & C Shock Absorbers
\$10 Per Set of 4**

—will make any Ford ride smooth and easy over country or city roads. They are the one shock absorber for Fords, that do more than you expect—Gilbert Southwick.

Say "W & C" to your dealer. He knows.

Dealers write for liberal offer

P. H. WEBBER CO.
HOPESTON, ILLINOIS



Engineers Select Pitter Fan

Where More Air Is Essential for Cooling



THE PITTER MULTI-BLADE FAN

Where proper cooling is the most difficult of all problems—on truck and tractor attachments for Ford cars—you will find that engineers have recommended, and manufacturers have almost universally adopted PITTER Multi-Blade Fans.

PITTER has made good in competition with other fans in manufacturers' tests, and in our own. Backed by our new Detroit factory—up-to-date and perfectly equipped—there is practically no limit to the service we can render manufacturers and cooling engineers.

The PITTER Fan is a multi-blade design producing high air velocities at comparatively low speeds. The blade width is cut down to a dimension that will deliver all the air that comes in contact with the blade and reduce to a minimum the skin friction and dragging of "dead air" in the direction of rotation. To each arm there are two blades, placed one behind the other with a spacing interval of such dimensions as will enable the rear blade to do its full amount of effective work. In this manner is obtained a fan whose total blade area is fully equal to the blade area of other fans of corresponding diameters, but the area of the real working surface resolved into its component of axial discharge is practically doubled.

The PITTER blades are curved and are designed upon equal radii of curvature, pitched to the same angle. As the fan rotates, the blades individually pick up air from a point immediately along their leading edges, and, due to their pitch and curvature, discharge it in a direction parallel with the fan axis.

The PITTER Fan, at any given speed, will deliver at least one-third more air than any other disc fan of similar diameter. For any given volume of air it will consume at least 40% less power than any other disc fan of similar diameter. Its most efficient speed is a low speed (in the neighborhood of 1000 R.P.M. varying slightly with the design) which is an entirely new departure in the disc fan design.

The Pitter Multi-Blade Fan Will Interest You

Let our Engineering Department figure on your specifications.

Write for blueprints and engineers' reports today.

The Pitter Fan Company
208 S. La Salle St. CHICAGO

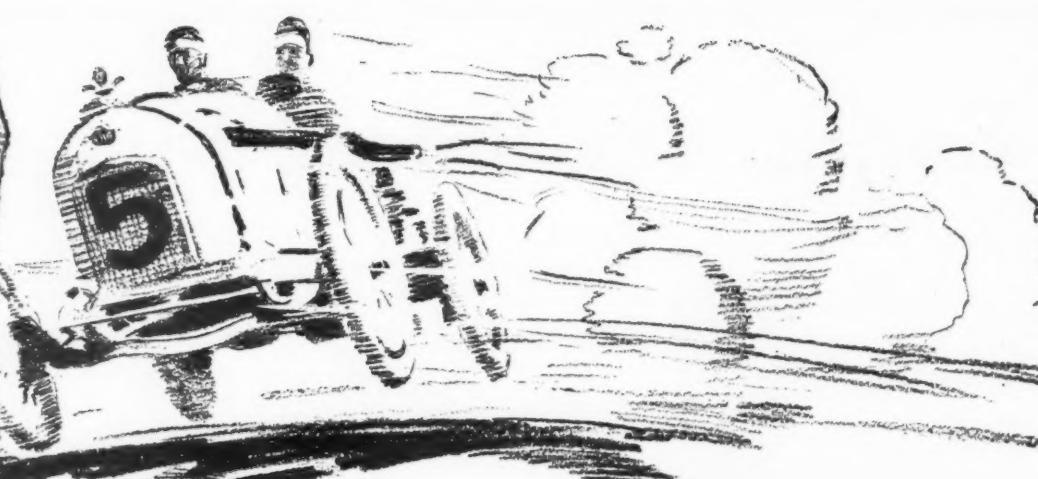


The Pitter Fan for Fords

PRICE

The PITTER Multi-Blade Fan for Fords is guaranteed to draw 50% more air through the radiator than the regular Ford fan. Fits any Ford car. Sold by all dealers and jobbers. Write.

\$3



Wisconsin CONSISTENT. MOTOR WINS CHICAGO CLASSIC

Again Wisconsin Motors have scored first place! This time on the Chicago Speedway, in the third annual Derby, when Earl Cooper, driving a Stutz, averaged better than 103 miles an hour in a terrific contest of speed and endurance. Not a single stop in the 250-mile race; such was the remarkable performance of the consistent Wisconsin. In winning this race

Wisconsin Engineering Triumphs

for the fourth time this season in speedway contests. At Los Angeles, in the Ascot Race, Feb. 30th, a Wisconsin-powered Stutz finished first; in the Uniontown Race, May 9th, Taylor, in a Newman-Stutz, captured first honors with a Wisconsin Motor; and at Cincinnati, on the Sharonville track, Cooper, in his Stutz, took fifth place in spite of four tire changes. Entries were made in each of these contests.

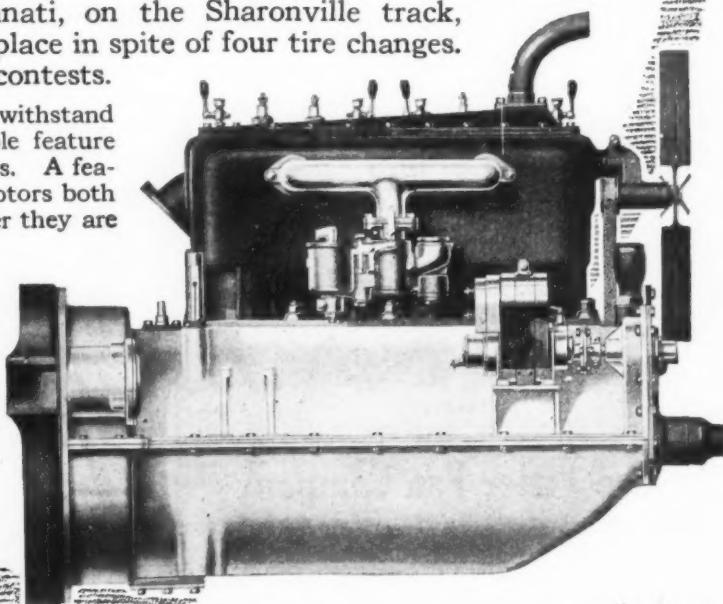
Consistent performance—ability to withstand the terrific strain—has been a notable feature of Wisconsin Motors in all these races. A feature characteristic of Wisconsin Motors both on and off the speedway wherever they are in service.

Wisconsin Motor Mfg. Co.

Sta. A Dept. 310

Milwaukee, Wis.

New York Branch—21 Park Row,
T. M. Fenner, Factory Rep.
Pacific Coast Distributor—Earl
T. Cooper Co., 1428 Bush
St., San Francisco, Cal.,
and 1310 So. Los
Angeles St., Los
Angeles, Cal.



Please mention The Automobile when writing to Advertisers



RAJAH SPARK PLUGS HELP COOPER WIN CHICAGO SPEEDWAY RACE

Cooper, first, and Hearne, fourth, both used Rajah Spark Plugs in the big Chicago Speedway Race on June 16th.

Twelve out of 27 cars starting were Rajah equipped.

Five out of the first 7 cars finishing had

RAJAH SPARK PLUGS

Performance sells better than claims. Rajah Spark Plugs win resales for dealers for the same reason they win races for drivers. They perform.

Dealers should familiarize themselves with Rajah racing records. The plug that meets these exceptional tests is the plug to talk up over the counter, confident that it will make good in your customers' cars.

RAJAH TERMINALS



Rajah Regular Clip Terminal

Adjustable to any cable. With the extra collar supplied fits any make of plug.



Rajah Ferrule Clip Terminal

With any size ferrule required. Fits any make of plug with the extra collar supplied.



RAJAH
Rajite



RAJAH

RAJAH TERMINALS AND ADAPTERS are furnished with Rajah Plugs so that they can be used with any car not equipped with the Rajah type of Clip Terminal. All racing cars are equipped with Rajah Terminals.

*Address RAJAH
Bloomfield, - - - - N. J.*

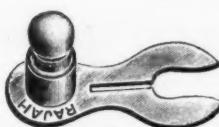
HUGHSON & MERTON, Inc.,
San Francisco, Los Angeles, Portland, Seattle
JOHN MILLEN & SON, Ltd.,
Montreal, Toronto, Winnipeg, Vancouver

RAJAH ADAPTERS



Rajah Thumb Nut Terminal

Adapter for Dodge, Hup, Hudson, Maxwell, Mitchell, Packard Twin Six, Pullman.



Rajah Stud Terminal

Adapter for Buick, Chevrolet, Oldsmobile.



Rajah Ball Terminal

Adapter for Franklin



Rajah Packard Terminal

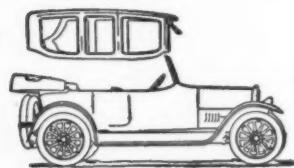
Adapter for Packard 4 and 6 Cylinder

KISSELKAR

EVERY INCH A CAR

Hundred Point Six

*Kissel's Original Idea That
Changed the Motoring
Habits of a Nation*



The ALL-YEAR Car

Kissel's idea—a real open touring car in which you can enjoy the beauties of nature to the utmost.

In cold and rainy weather transform it into a luxurious and handsome closed coach.

PRICES F. O. B. FACTORY

Touring-Sedan	•	•	\$1735
Roadster-Coupe	•	•	\$1735
Victoria-Town Car	•	•	\$2050
<i>Hundred Point Six</i>			
Standard Touring	•	•	\$1295
<i>Hundred Point Six</i>			
Gibraltar Body	•	•	\$1385
<i>Double Six 7 Passenger</i>			
Touring	•	•	\$2250
<i>ALL-YEAR Double Six</i>			
Touring Sedan	•	•	\$2650

HERE it is—the car whose very looks are proving an irresistible invitation to car purchasers to become familiar with our glorious country roads and mountain highways—a car whose appearance is that of a thoroughbred and in whose performance the most critical owners find nothing lacking.

The mechanical precision of the Hundred Point Six, its mighty Kissel-built engine, the generous use of the best bearings and bushings, its incomparable axles and brakes, insure unusually high efficiency and stability.

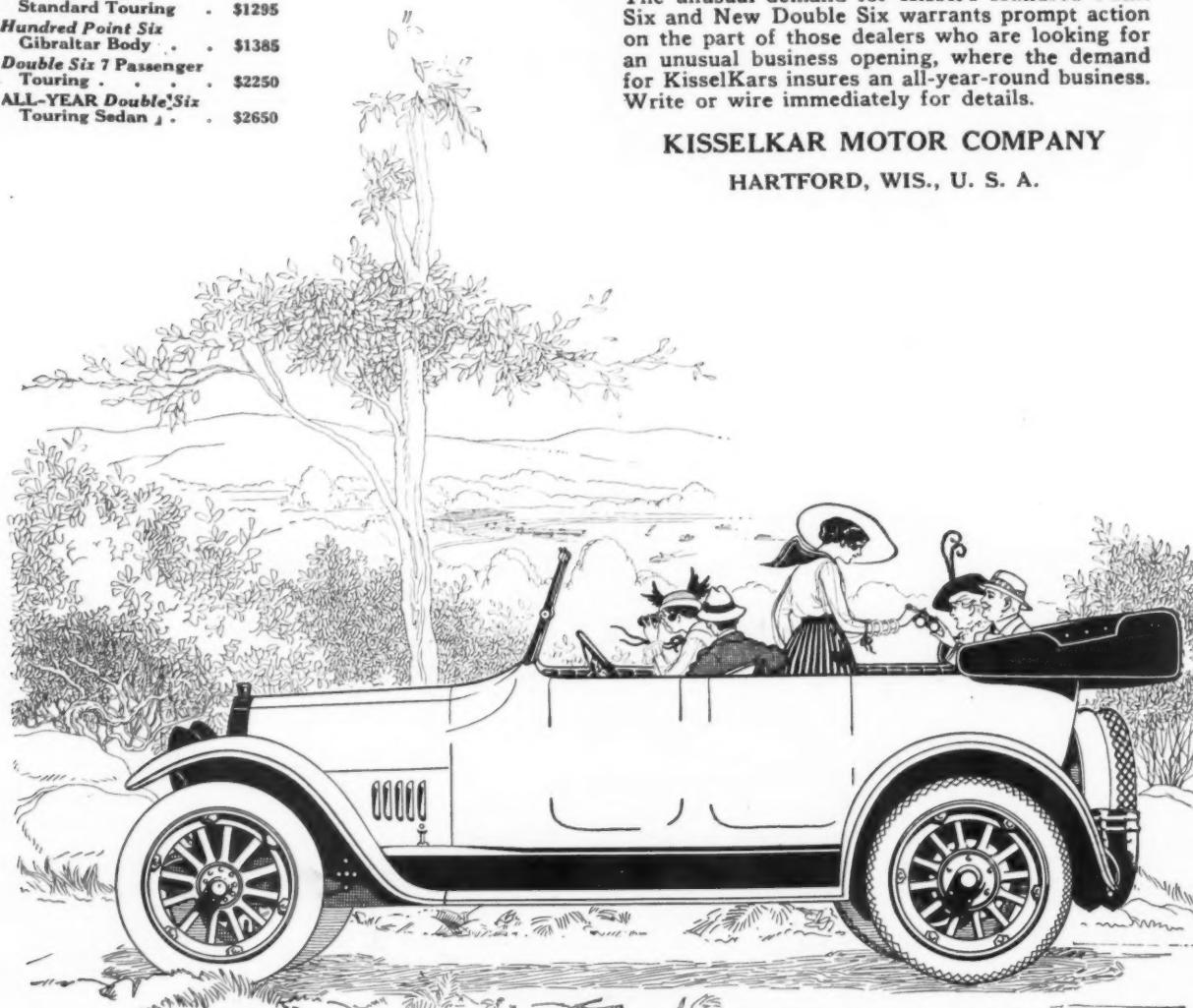
See your KisselKar dealer—and ride in this car of a Hundred Quality Features.

OPPORTUNITIES FOR DEALERS

The unusual demand for Kissel's Hundred Point Six and New Double Six warrants prompt action on the part of those dealers who are looking for an unusual business opening, where the demand for KisselKars insures an all-year-round business. Write or wire immediately for details.

KISSELKAR MOTOR COMPANY

HARTFORD, WIS., U. S. A.

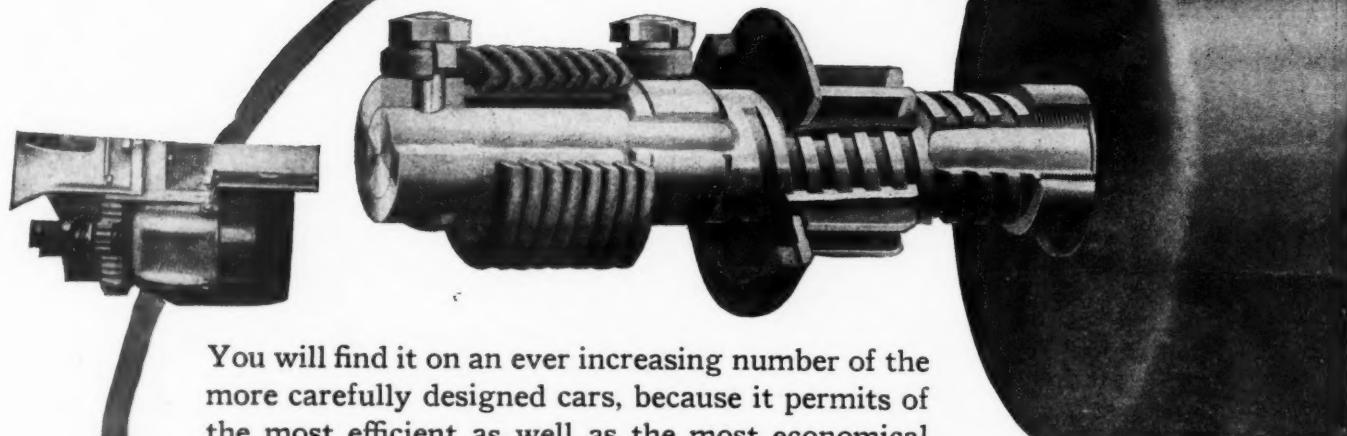


Please mention The Automobile when writing to Advertisers

O. K.'d by 153 Car Manufacturers

ECLIPSE-BENDIX DRIVE

Look for It



You will find it on an ever increasing number of the more carefully designed cars, because it permits of the most efficient as well as the most economical construction.

The following makes of cars are using the Eclipse-Bendix Drive as regular equipment:

Abbott-Detroit	Drummond	Kline
Allen	Duplex-Power	Lenox
All Steel	Eilar	Lesins
Alter	Elgin Six	Lexington
American	Emerson	Liberty
Ames	Empire	Lippard
Anderson	Enger	Stewart
Apperson	Erie	Little Giant
Auburn	Federal	Lozier Bros.
Austin	Fostoria	Madison
Bell	Garford	Marion
Biddle	Geneva	Handley
Bimel	Gerlinger	McFarlan
Bour-Davis	Glide	Meteor
Briscoe	Ghent	M. H. C.
Ben Hur	G. M. Truck	Mitchell
Canadian Overland	Gramm-Bernstein	Moline
Canadian-Regal	Grant	Knight
Case	Gray-Dort	McNaugh
Chalmers	Great Eagle	Monitor
Chandler	G. V. Truck	Monroe
Chevrolet	Hal Twelve	Moon
Coey	Halladay	Murray
Cole	Harroun	Napoleon
Collier	Hassler	Nash
Truck	Haynes	National
Columbia	Henry	Nelson
Commonwealth	Hupmobile	LeMoon
Crawford	Imperial	Norwalk
Crow-Elkhart	International	Nusco
Cummings	Interstate	Oakland
Daniels	Jackson	Ogren
Davis	Jeffery	Oldamobile
Demco	Quad	Overland
Detroit	Jones	Owen
Dile	Jordan	Schoeneck
Dixie	Kelly-Springfield	Paige
Doris	Kerno	Partin
Dort	Truck	Palmer
Drexel	King	Paterson
	Kissel	Pathfinder
		Peerless
		Penny
		Pilgrim
		Pilliod

The use of the Eclipse-Bendix Drive has made the two-unit type starting and lighting system—consisting of a small generator for constant running and a separate starting motor—superior to any other system. It has made it the most popular of any used today.

The Eclipse-Bendix Drive gives greater convenience in the arrangement of units, reducing the cost of construction and assembly, and securing better performance results. It gives a positive, even, noiseless, flexible and unfailingly automatic drive, with absolute protection against stripped gears.

Read over the list of starting and lighting systems using the Eclipse-Bendix Drive and the 150 makes of cars on which it is standard. It should convince you.

Eclipse Machine Company ELMIRA, N. Y.

Sales Agents:
Brandenburg & Company

New York: 57th St. and Broadway Detroit: Dime Bank Bldg.

Chicago: 1112 Michigan Avenue

Pilot	States
Premier	Standard
Princess	Stegeman
Pullman	Stephens
R. C. H.	Sterling
Regal	Stewart
Remington	Sun
Republic	Thomas
Riddle	Touraine
Roamer	Trumbull
Ross	Union
Rush	U. S.
Saxon	Velle
Scripps-Booth	Vulcan
Service	Westcott
S. G. V.	White
Singer	Willys-Knight
South Bend	Winton
S & S	Wolverine
Stearns	

A BIG tire for a big load. That is the "why" of Firestone Giant Truck Tires.

Extra wear, greater traction, smoother riding qualities, protection to truck and comfort for driver. These are the features that distinguish Firestone Giant Tires. You need these features. Call in the Firestone Transportation Specialist.

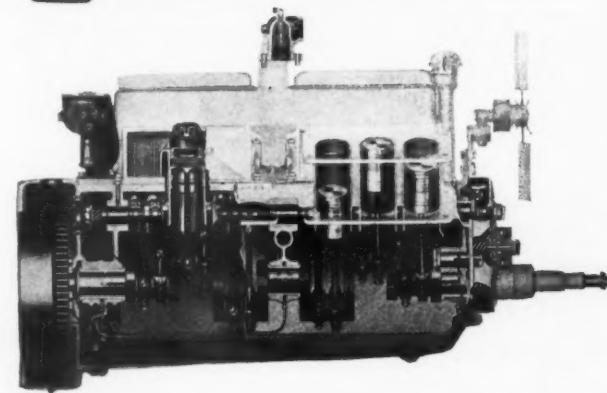
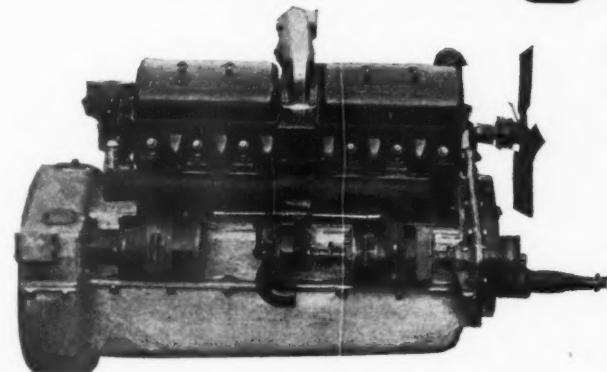
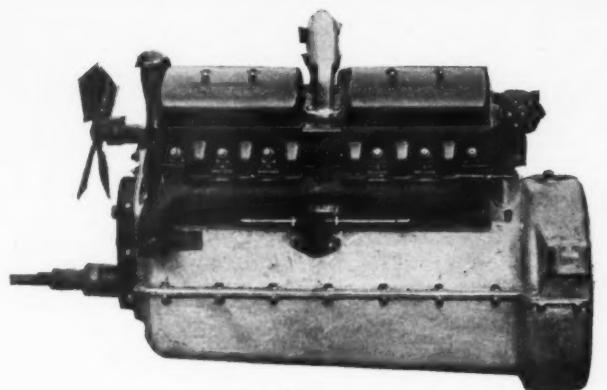
FIRESTONE TIRE AND RUBBER CO., AKRON, O.
Branches and Dealers Everywhere

The Business World Rides Best On-

Firestone
TRUCK TIRES

WEIDELY

12-Cylinder Motors



THE outstanding features of Weidely 12-cylinder V type motors are their surprising simplicity, their remarkable accessibility and their exceptional power due to their valves being located in head, to their light reciprocating parts and the large application of aluminum in their construction.

Other interesting constructional advantages are:

A Force Feed oiling system operated by gear driven pump supplies the three main bearings and through the drilled crankshaft supplies the connecting rod bearings.

A baffle plate in the crankcase just above the oil level prevents splash.

Connecting rods, crankshaft, camshaft, valve rocker arms, etc., all drop forged.

All moving parts enclosed.

All electrical equipment and water pump mounted on side of motor, leaving valve alley clear.

Spark plugs set in outer side of heads.

Carburetor suspended between cylinders from aluminum water jacketed intake pipe.

Water tunnel through crankcase from pump insures same temperature of water in each side of motor. Tunnel reinforced with steel tube.

Cylinders cast in triplets and staggered to allow side by side connecting rod construction.

Heads cast in sets of six, one on each side of motor attached to two sets of cylinders.

Valves in head operated by rocker arm and push rod construction.

Water circulation by pump driven from generator shaft.

Cooling fan belt driven from pump shaft has adjustment for taking up slack in belt.

Oil filler standpipe at front of motor.

Specifications

Bore— $2\frac{7}{8}$ ".

Stroke—5".

Piston displacement—389 cu. in.

Overall length of motor— $49\frac{1}{8}$ in.

Overall width of motor— $23\frac{9}{16}$ in.

Overall height of motor— $33\frac{5}{16}$ in.

Valve diameter— $1\frac{9}{32}$ in.

Crankshaft main bearings— $2\frac{1}{8}$ in.

diam.

Crankshaft conn. rod bearings—2 in.

diam.

Length crankshaft main bearings, rear 4", center $2\frac{3}{4}$ ", front $2\frac{1}{2}$ ", width crank pin bearing, $2\frac{3}{4}$ ".

Camshaft bearings— $1\frac{11}{16}$ " diam.

Length camshaft bearings—rear $2\frac{15}{16}$ ", center $2\frac{9}{16}$ ", front $1\frac{1}{8}$ ".

Crankshaft main bearings—babbitt.

Crankshaft conn. rod bearing—brass backed babbitt.

Width of timing gear face— $1\frac{1}{4}$ ".

For further information—write, or call on us.

WEIDELY MOTORS COMPANY
Indianapolis, Indiana



At Last! A Really Satisfactory Jack!

The Rees Jack is a *worm drive* jack. It lifts *steadily*—not by jerks. It is irreversible and cannot slip back; it does not run out when inverted.

You can *stand up* when operating it. You do not have to stoop and crawl even when *placing* the jack. The long handle (folded up when not in use) enables you to place it and operate it from a distance, as illustrated. It is the safest and most powerful auto jack made. Its worm gear construction is endorsed by leading engineers as the most efficient method of applying power to a jack.

And it is no larger nor heavier than other jacks. It fits in your tool box, handle and all.

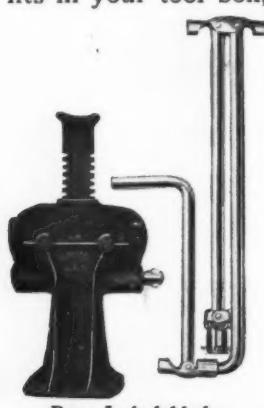
The REES was born and developed in railroad yards, lifting freight cars and passenger coaches.

Lifting an automobile is *play* for it—and play for the REES owner.

No autoist can see the REES Jack work and not buy one, if he has the money. He *knows* it is what he wants.

The jack is simple in construction. Only 4 working parts. No springs, pawls or ratchets. The handle is connected to jack by universal joint. Attached and detached by a twist of the fingers.

\$8.00



Rees Jack folded,
ready for tool box.

A Big Dealer Opportunity

This jack has it over other jacks "like a tent"!

Autoists buy it the minute they see it work. Selling at the same price as other jacks, there is no comparison in value. It is a perfect cinch to sell.

There is a good profit in it, and we can give you immediate and complete deliveries.

Wire or write us at once, giving the name of your Jobber, and we will send you full information concerning the REES Jack and what it means to YOU!

Get Busy—**TO-DAY!**

The Service Corporation

Frick Annex

Pittsburg, Pa.



Interior View. Only
four working
parts.



The combined area of these three plants aggregates the largest floor space in the world devoted to the exclusive manufacture of Die-Castings.

DOEHLER DIE-CASTING Co.

MAIN OFFICE AND EASTERN PLANT

BROOKLYN. N.Y.

WESTERN PLANT
TOLEDO. OHIO.

NEW JERSEY PLANT
NEWARK, N.J.

SALES OFFICES

CHICAGO
4414 NO. CAMPBELL AVE.

DETROIT
914 FORD BUILDING

ROCHESTER
726 GRANITE BUILDING

BOSTON
723 OLIVER BUILDING

**The Simple
Reasons
for
the Success
of
the**

SUNDERMAN
Vacuum Carburetor

**SUNDERMAN
CORPORATION**

5 Chambers St., Newburgh, N. Y.

Western Office
403 Kresge Building, Detroit

THE Sunderman Vacuum Carburetor has met with unexampled success on every one of 138 makes of pleasure cars and trucks on which it has been installed.

Remember, such installations have been replacements—the motor had been working unsatisfactorily; mileage, power and flexibility had been lacking.

Under these unfavorable conditions the

**Has Given Greater Power
and Sharply Decreased
Gasoline Consumption.**

The reason is plain. Its simple construction and the Sunderman principle of air intake at right angles to the multiple jets serve alike to eliminate adjustments and give a more complete break-up to the fuel particles.

A more complete vaporization of the fuel permits not only more *rapid combustion*, but it gives a greater *explosive force* to that combustion—all of which means more power from a given amount of gasoline.

The low and high speed jets supply the fuel in accordance with the demands made by the suction of the cylinders, and this fact, combined with the greater explosibility of the finer Sunderman mixture, insures the other requirements of the ideal carburetor—speed, flexibility and quick acceleration.

Every motor engineer in the country should call for a Sunderman test—either at his factory or at our Detroit Laboratory, and on any road, for any job that is in use to-day.

Where motor efficiency and economy of upkeep are sincerely desired by factory organizations, the Sunderman Carburetor makes its strongest stand.

Capt. Frederick Sunderman and his engineers are at your service for a test.

Please Write for Demonstration

The Great European War

has demonstrated beyond all doubt that hydraulic recoil checks are the most completely satisfactory for the big guns. The famous French "75's," admittedly the most effective guns in all the fighting, are equipped with hydraulic recoil checks.

Before the Great War, the HOUDAILLE (pronounced HOO-DIE) Hydraulic Spring Suspension, or Shock Absorber, had demonstrated its effectiveness to such an extent that it was made Standard Equipment on 14 different makes of European Motor Cars. It is built on the same principle as the recoil checks of the big guns.

This matchless shock absorber is now made in America, and can readily be demonstrated for the benefit of such automobile engineers or manufacturers as may be interested.

Its main advantages are that it has only one moving part, and one simple adjustment, that it is devoid of springs; that it moves always with equal and entire freedom in *one* direction, and in

the *other* direction with exactly the degree of resistance you desire. Adjustment is practically limitless.

Whether a car be heavy or light, large or small, and no matter what the style or size of its springs, the HOUDAILLE will fit it both as to proper arrangement of attachment and as to proper degree of resistance. Adjustment is made by a slight turn of set screw which is not subject to any strain; in fact *all* the strain comes on the Castor Oil as it is forced through the valves.

Not the slightest change in body or chassis of a car is necessary. One model HOUDAILLE for all cars, because of its universal application and limitless adjustment.

HOUDAILLE

(PRONOUNCED HOO-DIE)



Exhaustive tests are invited. We shall be glad to arrange such tests for car manufacturers without the slightest inconvenience or expense to them. Easily demonstrated in a short time.

Houdaille Shock Absorber Company, Inc.
1737 Broadway, New York



POVASCO STEERING WHEELS

"dress" the finest car. It is seldom that any part of the working equipment can contribute to the beauty as well as the utility of the motor car.

POVASCO wheels, with their molded construction, as beautiful as ebony, and more permanently durable, contain the soundest, safest and most convenient tilting feature of all the wheels on the market. Giving eight or nine inches more clearance, permitting easy entrance and exit from the driver's seat, they tilt forward or back, as required, and when set in any position are absolutely rigid.

Thus engineers and car designers are sure that the steering wheel can never fail in any emergency.

Send for the POVASCO catalog to-day, and learn more of this splendid line.

Our Car Dealers' Proposition is as good as a Liberty Bond—Ask us about it.

Pouvailesmith Corporation

Poughkeepsie, New York

POVASCO
De Luxe
molded
construction,
patented, with
tilting and
hand-heating
features.



FAFNIR

QUALITY
BALL



SERVICE
BEARINGS

Quality in Fafnir Ball Bearings begins with the Raw Material.

Special steel is used exclusively in the manufacture of Fafnir Ball Bearings. This steel contains the proportions of chromium and carbon found to be most conducive to extreme resistance to wear.

Before entering our Production Department, samples of each lot of steel are systematically examined in our laboratory, as follows:

Chemical Analysis—in order to ascertain whether the composition of the steel is in accord with our specified standards.

Brinell Test—for determining whether the steel has been properly annealed.

Examination of fracture to reveal the soundness and uniformity of structure.

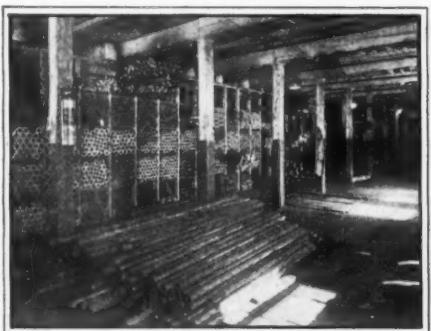
Preliminary Hardening to test the ability of the steel to properly harden and become tough under the influence of heat treatment.

All steel must strictly conform to our inflexible standards of quality.

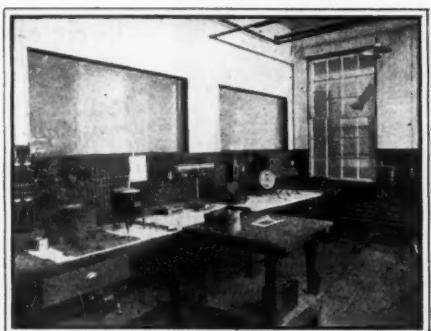
May we send our new Catalog



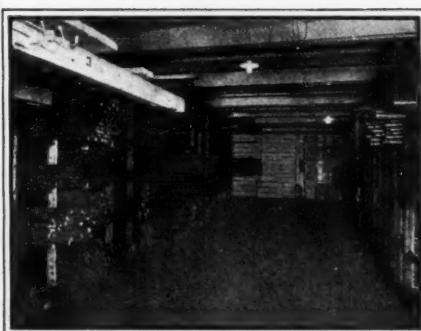
View in Stock-Room



Corner of Laboratory



View in Stock-Room



The Fafnir Bearing Company

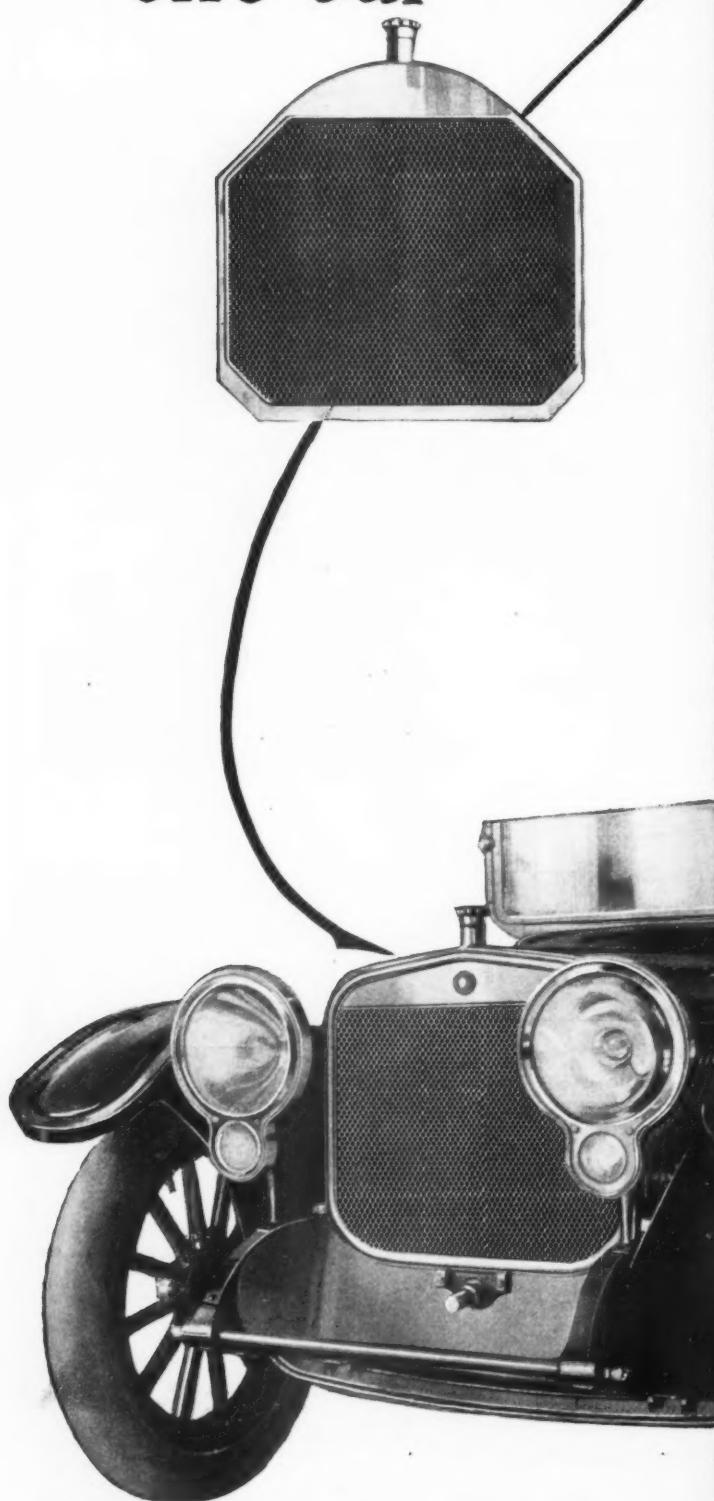
Conrad Patent Licensee

Detroit Office:
752 David Whitney Bldg.

Main Office and Factory:
New Britain, Conn.

Chicago Office:
39 So. Clinton Street

The Radiator identifies the car—



A DISTINGUISHING radiator individualizes the car on which it is placed. It endows that car with a personality that cannot be overlooked—enables the interested onlooker to instantly choose from all that pass—the car equipped with a Fedders Radiator.

The radiator is the face of the car. No other one feature adds more to the appearance or expresses more character. And while Fedders Radiators blend perfectly in the building of a car of utmost beauty of design, in still greater degree they contribute to the perfect operation of that car.



Through 13 years of radiator manufacture "Fedders" has stood for sterling worth. In the gruelling test of racing service they have won and held unequalled honors.

Their continued use by the makers of the highest grade cars through a long term of years is proof positive of their inbuilt quality.

Fedders Radiators dominate the Motor Truck field. No greater endorsement could be attained than the fact that Fedders Radiators have for years met the exacting demands of commercial car service.

FEDDERS MFG. CO., Inc.
BUFFALO N. Y.



Baush Worm Gears for Automobile Axles

Every Baush worm gear is a masterpiece.

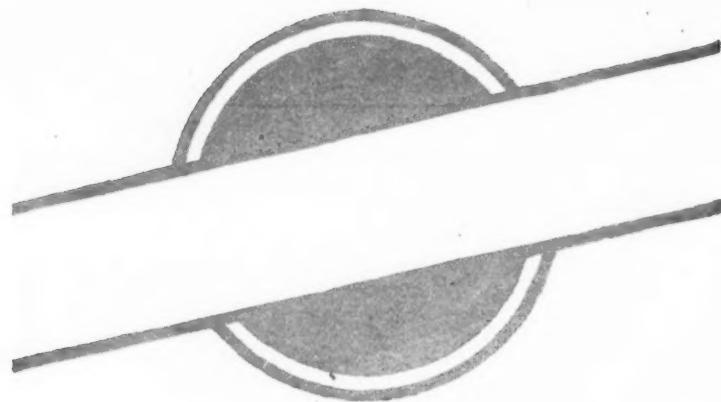
Long experience, the best of materials, unequalled manufacturing facilities, and a most rigid inspection make this fact a continuous certainty.

And yet the same factors operate to keep our costs down, by eliminating spoiled or unsatisfactory work, making every customer a booster, and enabling us to cut corners in all legitimate ways.

Let us quote on your requirements

Baush Machine Tool Company
Springfield, Mass.

Detroit Office:
Dime Bank Building



American Extravagance

A is giving away to American thrift. More value per dollar expended is being exacted than ever before. This company's tremendous production guarantees quantity price together with quality value, consequently quantity sales with quantity profits.

See announcement next week

For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit, Michigan. Inquiries marked "Confidential" will be answered direct by MOTOR AGE and so treated.

ELCAR

ELCAR

The Elcar at \$845 Does Its Own Talking

A Few Elcar Specifications

Wheel Base—As long as some cars selling up to \$3,000 and more—115 in. **Motor**—4-cylinder; long stroke; high speed; 34.7 h. p. at 1,800 r. p. m. **Fuel Supply**—Stewart vacuum system. **Ignition**—Delco automatic spark advance with manual control.

Starting and Lighting—Dyneto two-unit; double-bulb headlights; Willard storage battery.

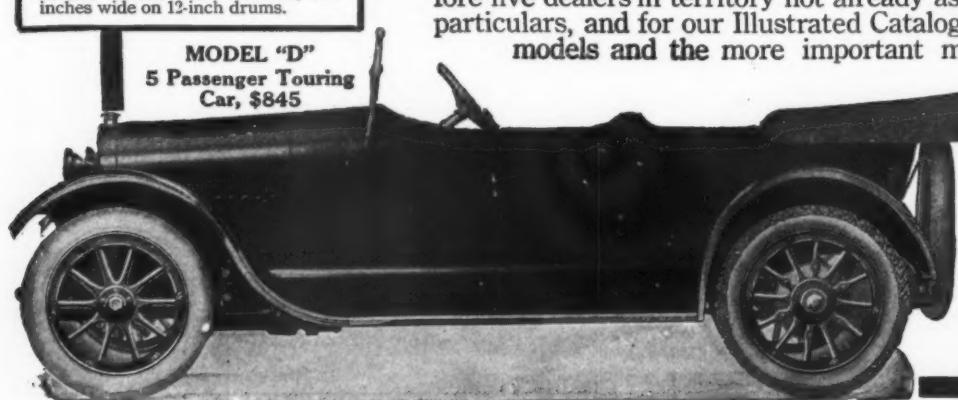
Clutch—Dry multiple disk—seven plates, steel on Raybestos.

Rear Axle—Full-floating with roller bearings at each end of wheel hubs.

Differential—Spiral bevel driving gears, with roller main bearings and ball thrust bearings.

Brakes—Internal and external, two inches wide on 12-inch drums.

MODEL "D"
5 Passenger Touring
Car, \$845



Three Models at One Price

Five Passenger Touring Car Four Passenger Touring-Roadster
Two Passenger Roadster

Secure it for your territory

We want to place our proposition before live dealers in territory not already assigned. Write us for particulars, and for our Illustrated Catalog showing all ELCAR models and the more important mechanical parts, and describing the construction of the ELCAR even down to its small details.

Elkhart
Carriage & Motor
Car Company
C778 Beardsley Avenue
Elkhart, Indiana



It is our firm conviction that the intrinsic worth of any mechanism, sooner or later, will be accorded its due recognition; and that the producer will accordingly benefit in full measure.

WRIGHT *Taper Roller* **BEARINGS**

It is with this confidence, then, born of a knowledge of the merit of our product, and an understanding of our ultimate clientele, that we invite all mechanical men and their principals to procure a copy of the booklet describing our taper roller bearing, so that they may obtain a technical description of what we believe to be the most efficient bearing ever produced for the work it is designed to perform.

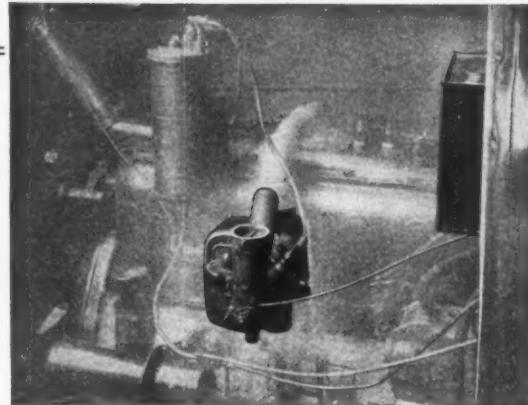
WRIGHT ROLLER BEARING CO.

CROZER BUILDING, PHILADELPHIA, PA.

Factory: Spring City, Pa.

G-P Coal Oil System

Ready for
18 Different
Types of
Cars



On Continental 6-45 Motor

Can Be Built
to Any
Manufacturer's
Specifications

G-P Coal Oil System Uses Kerosene and Distillate in Place of Gasoline

Settle
the
Gasoline
Fuel
Crisis

There is one way to keep cars running—in the face of a gasoline famine—without draining the country of gas. The answer is KEROSENE and DISTILLATE. **G-P COAL OIL** System handles all lower grades of fuel as well as gasoline. Starts on small amount of gasoline, and switches to other fuel. It may be the means of keeping your cars in service.
Increases mileage, speed and power. Reduces lubrication cost. Cuts fuel expense 66 per cent, and burns what your owners will be able to buy.
A request for details will be well worth your while. Ask for official AAA Test Report.

G-P COAL OIL SYSTEM COMPANY
1806 MICHIGAN AVENUE CHICAGO

Patented and Patents Pending—Beware of Infringers.

Operate Cars
Cheaper
Without
Exhausting
Valuable
Resources

HALLADAY BUMPERS

PROVIDE PROTECTION For the Front and Rear of Every Car

The prevalence of extended front aprons and the great variation in fender aprons and frame construction now necessitate corresponding variation in Bumper designs to fit all cars.

In the Halladay Line we offer such variation with the least possible complication of parts.

The dealer in Halladay Bumpers is prepared to meet all demands and turn all prospects into buyers without a great investment in stock.

Bumpers are the best selling Automobile Accessory of today and the Halladay Line is the Best Selling, Most Profitable and Most Satisfactory Line in the market.

Wise dealers: Reflect and get busy.

Write us or our jobbers for catalog and full details

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DISTRIBUTORS:

Gray-Heath Co., 1440 Michigan Ave., Chicago, Ill.

E. L. Thompson Co., 817 Boylston St. Boston, Mass.

Sanford Brothers, Chattanooga, Tenn., Southern Distributors

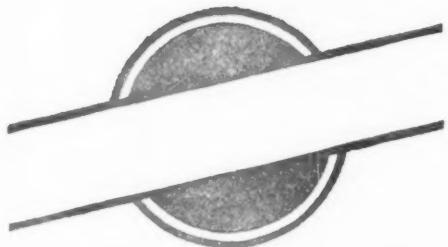
Hughson & Merton, Inc., San Francisco, Los Angeles, Portland and Seattle, Pacific Coast Distributors

80% of all cars

are used partly or
wholly for business.

Economy is demanded of the business car. Big gasoline, oil and tire bills show up disagreeably in the expense record. The light weight, big gasoline and tire mileage of this company's cars is a forcible sales factor.

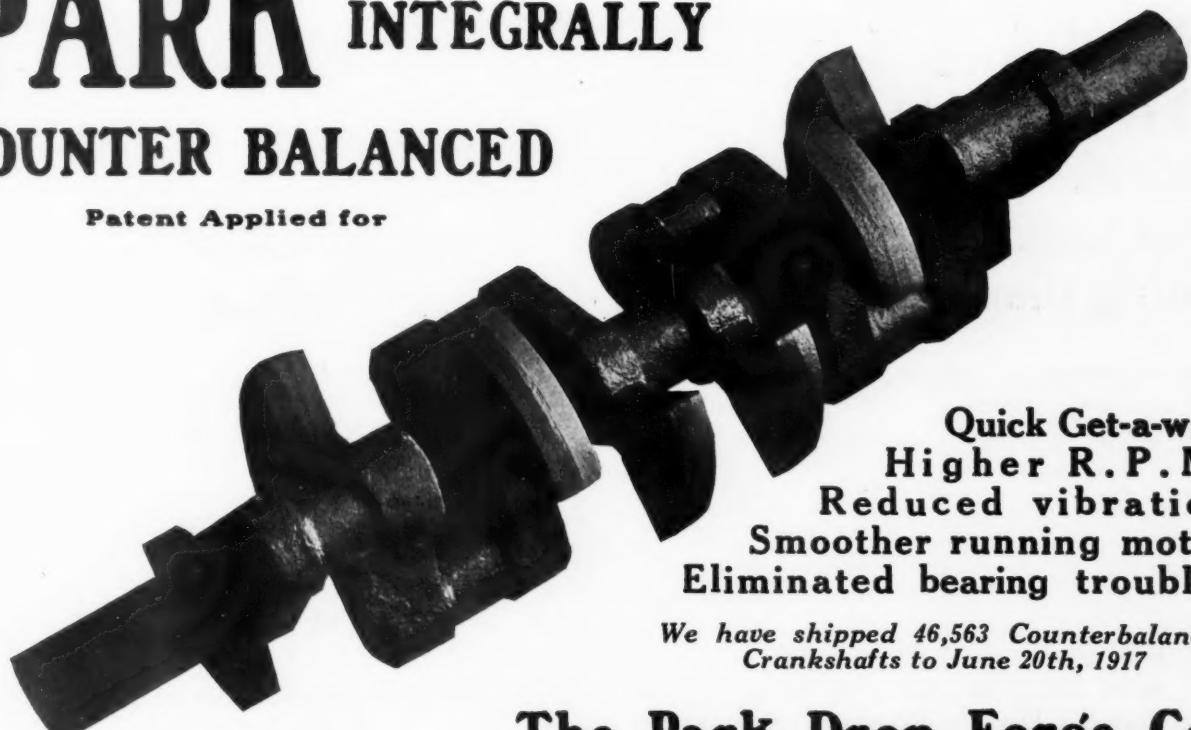
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PARK INTEGRALLY COUNTER BALANCED

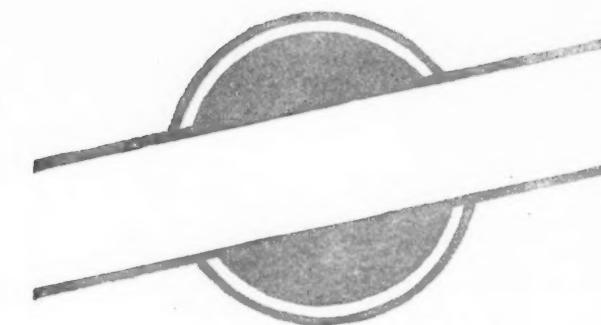
Patent Applied for



Quick Get-a-way
Higher R.P.M.
Reduced vibration
Smoother running motor
Eliminated bearing troubles

We have shipped 46,563 Counterbalanced Crankshafts to June 20th, 1917

The Park Drop Forge Co.
Cleveland



Dealers and Distributors representing this concern have been uniformly successful—have made money—from the start. 90% recontracted last year. The reasons: volume-production, volume-prices, volume-profits.

The opportunity for bigger business — bigger profits — with this concern today is more interesting than ever.

See announcement next week

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Please mention The Automobile when writing to Advertisers



Manufacturers Save Time Shipping Parts IN

"BULLDOG" Mailing Bags

Eliminate the waste in time and money, now taken up to wrap, tie and tag your packages. Save enough in postage to more than pay for bags.

"BULLDOG" Mailing Bags are made of cloth. Strong and compact. Fasten with draw string.

Come in all sizes for all requirements. A perfect package for Parcel Post use.

We also manufacture cotton bags for packing auto tire chains, inner tubes, grease cups, ball bearings, etc. Send for prices and full information.

NATIONAL BAG COMPANY

105 Main Street
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Always Delivered With Care



Manufacturers:

DO YOU WANT

to find a quick and sure way of placing your surplus manufacturing work?

THE CONTRACT WORK DEPARTMENT,

page 284, gives a real answer—

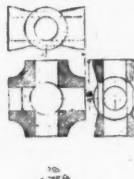
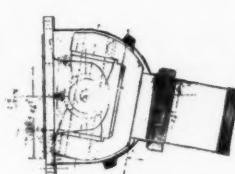
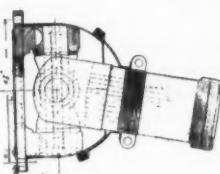
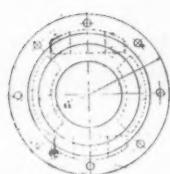
Service

Contract Work Department
THE AUTOMOBILE

KINSLER-BENNETT

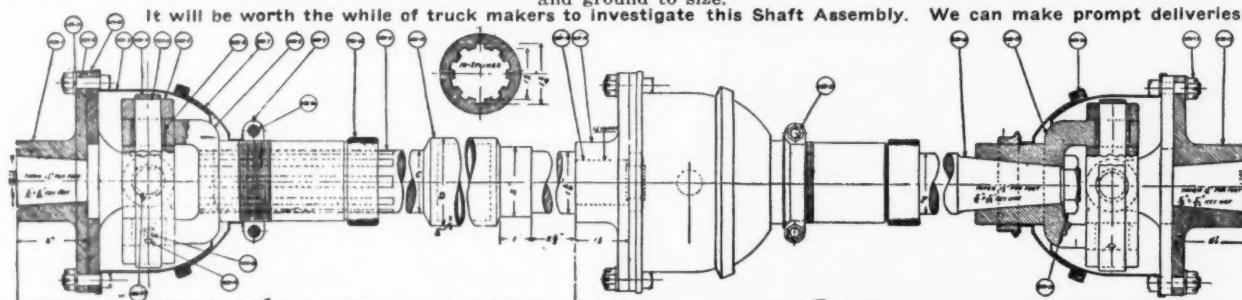
New Universal Joint, No. 580

Built for heavy duty trucks 5-7 ton capacities



Three Joint Shaft Assembly, No. 450

Built for heavy duty trucks of 2, 3 and 5 ton capacities. Made from drop forgings, heat-treated. All wearing parts are case hardened and ground to size.

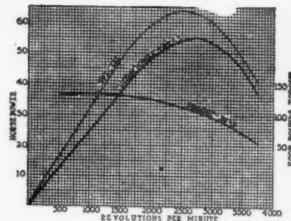
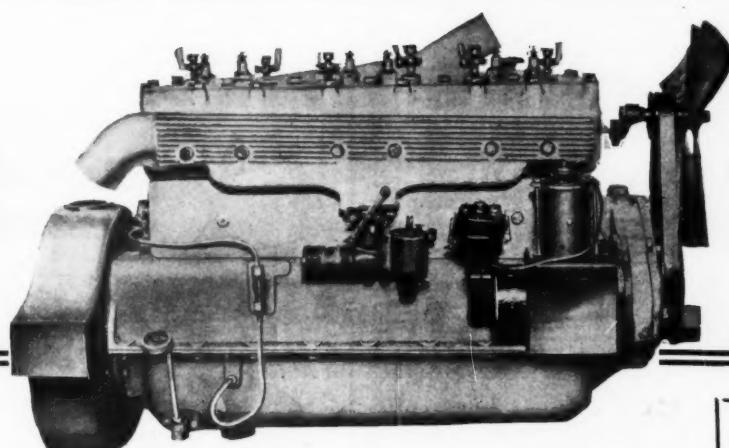
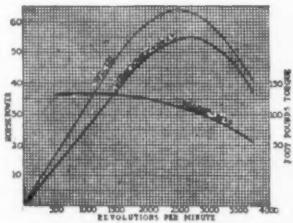


It will be worth the while of truck makers to investigate this Shaft Assembly. We can make prompt deliveries.



The Trade-Mark that stands for Quality and Service.

The Kinsler-Bennett Company
Hartford, Conn.



A Motor With Extraordinary Features

THE LEWIS "SIX" embodies the very latest features recommended by leading motor authorities.

A multiplicity of parts has been avoided by a scientific combination of related units.

Outside and accessory parts have been eliminated so far as possible, so that the engine presents a smooth, clean appearance.

By a scientific combination of the exhaust and intake manifolds, practically dry gas is delivered to cylinders, giving power and

smoothness with extraordinary economy and freedom from carbon.

The LEWIS develops about 55 H.P. at 2750 r.p.m. With special tuning it has reached about 65 H.P. at 2500 r.p.m.

Cooling and lubricating systems are unusually efficient, reliable ignition is assured, all parts are accessible and more readily understood and cared for by reason of simplicity of arrangement.

Write for Full Description

LEWIS MOTOR CORPORATION, Detroit, Michigan

LEWIS "SIX" MOTORS

3 1/4 x 5 cast in block integral with crank case.

Exhaust and Intake Manifolds combined in one casting.

Crankshaft inherently balanced in respect of rotational stresses.

Water circulates on both sides of cylinder heads.

Starting and Lighting System mounted by means of piloting directly into crankcase opening, eliminating brackets; insures absolute alignment of shafts, making them oil-tight.

Know Your Truck Mileage



DREADNAUGHT *Indestructible* Hub Odometer

— is guaranteed indestructible.
— replaced free of charge if broken in collision. Cannot be tampered with. Figures always show right-side up.

American Taximeter Company

*Manufacturers of Jones and Popp
Taximeters*

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Service Stations in New York, San Francisco, New
Orleans, Washington, Chicago, Detroit, Boston,
Pittsburg, Philadelphia, Seattle, St. Louis,
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SHEET METAL STAMPINGS ARE STANDARD

With the largest presses in the industry and a complete and modern plant for annealing, case hardening, nickel plating, electric and oxy-acetylene welding, we solicit your inquiries and orders.

Estimates cheerfully furnished on your requirements.

AUTOMOBILE STAMPINGS WE MAKE A SPECIALTY OF:

Axle Housings	Torque Arms
Brake Drums	Fan Blades
Wire Wheel Hubs	Felt Retainers
Hub Caps	Brake Bands
Ball Cups	Housing Covers
Ball Retainers	Wrenches
Clutch Discs	Running Boards
Clutch Cones	Washers
Step Hangers	Clutch Spiders

Etc.



THE BOSSERT CORPORATION
UTICA, N. Y.

5,000 dealers
and distributors
who are now
handling non-com-
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should with the ad-
dition of this car and
truck to their line be
able to multiply their
sales opportunities
and increase materi-
ally their *earning*
capacity.

See announcement next week



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MOTOR AGE, 95 West Fort St., Detroit,
Michigan. Inquiries marked "Confiden-
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AGE and so treated.

THE MARK OF A BETTER RADIATOR

Quality RADIATORS

for
Pleasure Car
and
Heavy Duty
Service

G&O Mfg Co.
New Haven, Conn.



DRIDEK

Is a Remarkable Waterproof Material That Makes a Most Satisfactory Automobile Top

Soft, pliable, folds easily, looks well and stands up under hard service.

The manufacturer that furnishes a DrideK top with his car shows an endeavor to increase the value of his product.



BULL DOG QUALITY in Rubberized Fabrics and Rubber Cloths is the leader in exclusive designs and water resisting fabrics.

Send for samples and price lists of DrideK and BULL DOG QUALITY Fabrics.

L. J. Mutty Company
Boston, Mass.

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**WASHERS
GASKETS
WICKS
STRIPS, ETC.**

¶ A factory, equipped to best supply the special needs of the AUTOMOBILE TRADE.

¶ Put the burden of Proof upon us—write today. There's conviction waiting for you.

ADVANCE FELT SPECIALTY & CUTTING CO.

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**CHECK MAPS DESIRED
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**GULF REFINING COMPANY
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PITTSBURGH, PA.

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CITY

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Bigger Profits
For
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Dealers

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GREY IRON
CASTINGS
SEMI-STEEL

Daily Capacity 200 Tons

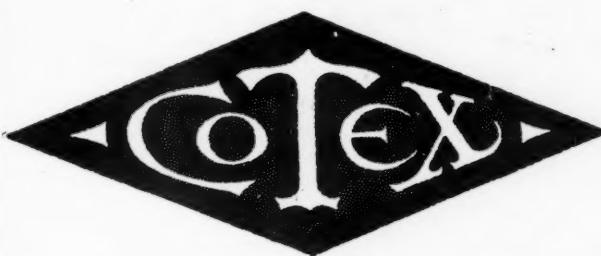
Our plant, equipment and organization are particularly adapted to quantity production of castings for cylinders, gas engine parts and work of a kindred nature—up to one ton in weight.

We solicit work to comply with the most exacting physical and chemical requirements.

Constant inspection of work in process combined with daily tests of raw materials and the finished product in our own laboratories, guarantees to our customers a minimum of defective castings and a consequent saving of machine shop losses.

Immediate Deliveries

Campbell, Wyant & Cannon Foundry Co.
MUSKEGON MICHIGAN



**Coated Textiles
of
Highest Quality**

We manufacture artificial leather, or leather cloth, for upholstering and trimming automobiles.

Our product is used extensively by the largest manufacturers.

Our plant is modern in every respect and enables us to manufacture a uniformly high-grade product.

We make special goods for special purposes, and



will solve your upholstery problems.

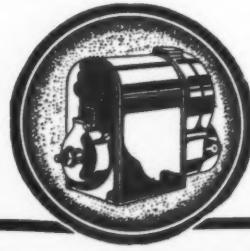
We invite inquiries

The Cotex Company
NEWARK NEW JERSEY

*A Policy of
giving the
dealer his due
—passing pros-
perity around—
makes a dealer's
contract with this
concern a cher-
ished acquisition
—generally at a
premium.*

For advance information wire
or write MOTOR AGE, 95
West Fort St., Detroit.

See announcement
next week



There's One Big Thought Behind The Eisemann

Through sixteen years of consistent progress and improvement—the longest time that has been spent in developing any High Tension Magneto—there has been no change in our original purpose.

To hold the cost of the Magneto within reasonable limits and to excel in compactness and appearance—these are important objects which have received their full share of attention from the Eisemann Engineering Staff.

But no one of these considerations has been allowed to interfere with the one dominating Eisemann purpose. Our fixed determination has been to make the *most efficient* Magneto.

And so we are making it. For proof, consult the long list of truck, car and tractor makers who use Eisemann as standard equipment.

THE EISEMANN MAGNETO CO.
Sales and General Offices: 12-33rd St., Brooklyn, N.Y.
Chicago, Ill., 910 S. Michigan Ave. Detroit, Mich., 802 Woodward Ave.

THE
EISEMANN
MAGNETO

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FORTY-THIRD ST., NEAR BROADWAY



Located just off Times Square

The Hotel Woodstock

is within a handy walk of everything—terminals—subways—elevateds—surface lines—theatres and the automobile district, yet you can have quiet, refinement and service withal.

Single Room, with Bath . . . \$2.00 and \$3.00 for one
Single Room, with Bath and Two Beds, \$4.00
and \$5.00 for two

European plan restaurant
unexcelled for its cuisine

Service and accommodations unsur-
passed for completeness and efficiency

Write for our Map of New York

W. H. VALIQUETTE
Managing Director

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May we send you this guide of Niagara Falls

TOURISTS planning to visit Buffalo and Niagara Falls can get a good guide with the compliments of this fire-proof hotel. Contains photographs of important landmarks and features—also road map of Buffalo, Niagara Falls and surrounding country. Send for this 16-page booklet today.

HOTEL Lenox is located ideally for tourists—on highest point in Buffalo—surrounded by elms—on a quiet, exclusive street, a few minutes from downtown. European plan as follows:

*Room with privilege of
bath, from \$1.50 per
day.*

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bath, from \$2.00 per
day.*

*Two rooms with pri-
vate bath, from \$4.00
per day.*

C. A. MINER
Managing Director



North St. at Dela-
ware Ave.
Tourists follow Main St.
or Delaware Ave. in to
North St.
On Empire Tours write
for N. Y. State road guide.

REVOLUTIONS PER MINUTE

LE ROI MOTOR
3 1/8 x 4 1/2 MODEL C
FOR THE LIGHT ROADSTER
TOURING CAR
OR
TRUCK

Used by leading manufacturers of best-known American-made light trucks.

The business of manufacturing Le Roi Engines, formerly conducted by Milwaukee Machine Tool Co., is now carried on by

LE ROI COMPANY

Mitchell St. and 60th Ave.
MILWAUKEE, WIS.

Write for Complete
Information

There is a considerable amount of pride to be taken in representing a motor car which is internationally renowned—seen and respected in every civilized country on the globe.

See announcement next week



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AITCHANDEE
"TRADE-MARK REGISTERED"
Shock Absorbers

"Iron" the Road for Fords

"They add thirty inches to the wheelbase." That's what one man said about the Aitchandee Shock Absorbers on his Ford. They impart the smooth glide of the long, heavy car to your Ford. 100,000 in use.

Original Cantilever Type. Tension on upward and downward thrust different. Makes the body "ride on an even keel."

Comfort First. Aitchandees break the rebound; end the jiggle and jar; make steering easier.

Save Tires, also reduce wear and tear on engine and transmission.

Your dealer will put them on while you wait. Single arm, set of four, \$10.00; Twin arm, set of four, \$12.00. Guaranteed for the life of the car. Write for booklet.

The H. & D. Co., Inc. **Goodland, Indiana**
Dealers—Write for Proposition

Use the facilities of this perfectly equipped plant for the production of small sheet metal stampings of any design, also

BRASS CASTINGS
in the Rough, Polished or Nickel Plate

including Hub Caps, Radiator Filler Necks with Caps, Gasoline Tank Flanges with Caps, Gasoline Tank Flanges for Outlets, Hood Yokes, Ford Special Hub Caps and other parts made of Cast Brass.

Our Well-Equipped Wood-Working Department

is prepared for the prompt production of quantity orders of rough or highly finished wood-work assemblies of medium size for motor car construction, such parts as rest blocks for shipping, dooring boards, back spring boards, running boards, etc.

We work from Blue Prints and Specifications, but prefer, when possible, to also have samples for the purpose of securing positive accuracy in weight, measurements and design.

Write us at once for further information regarding the production of your requirements.

The Pfau Mfg. Co. **Cincinnati Ohio**
230 Mentor St.

Bigger Profits

for Automobile Dealers. See Announcement Next Week. For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit.



22-73 SERIES

They follow closely the lines of the preceding series, and the only changes are in the nature of refinements.

- 22-73 Touring
- 22-73 Sporting
- 22-73 Runabout
- 22-73 Raceabout
- 22-73 Touring-Limousine

Literature Mailed on Request

MERCER AUTOMOBILE CO.
400 Whitehead Road Trenton, N. J.

In Stock—for Every Car



Write FOR CATALOG AND DISCOUNTS

DISPLAY RACK FREE WITH ORDER FOR 12 ASSORTED

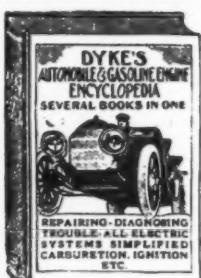
Jenkins Vulcan Spring Co.

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Fort Worth, Tex. 708 Commerce St.
Sumter, S. C. 29 Caldwell St.



Nothing in the World like it - for Power-

Lycoming Foundry & Machine Co.
Williamsport, Pa.



DYKE'S Automobile and Gasoline Engine Encyclopedia

—tells you how to diagnose and remedy any trouble.
—teaches you the principle of all engines, valves, carburetors, ignition, self-starters—in fact, everything you want to know.
—teaches you to overhaul a car from the ground up; how to make all repairs, etc.

NOTE—The revised Book is now ready with many new subjects added. The electric section of the book is up to date and thoroughly treats on the principle, construction, operation and care of leading Electric Starting, Generating, Ignition and Lighting Systems. Delco, Atwater-Kent, Bosch "two point" and other systems are simplified.

FORD INSTRUCTION—complete—now added.

SIX, EIGHT & TWIN SIX engines simplified.

FREE supplement with Encyclopedia treating on construction and adjustments of the Packard Twin Six, King Eight and Ford.

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241-249 W. 39th Street, New York

MOTOR AGE

Only weekly devoted to the interests of car owners and dealers
he recognized "Motoring Authority of America"

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uarantees to increase your motoring pleasures and reduce your upkeep expense
Established in 1899

MALLERS BLDG.
CHICAGO, ILLINOIS

Watch for epoch-making announcement next week to automobile dealers and distributors.



For advance information wire or write MOTOR AGE, 95 West Fort St., Detroit.

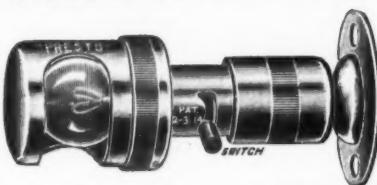


One of the
most efficient
and prosperous,
smoothest working and
best satisfied dealer
organizations in the
industry is the organi-
zation you may have the
privilege of represent-
ing. *See announcement next week*



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mation wire or
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AGE, 95 West Fort
St., Detroit.

Presto Dash Lamps



For Standard Equipment

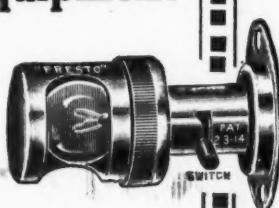
On All Cars

PRESTO Dash Lamps are ready for delivery in a wide variety of styles. They meet every requirement of dash lamps, and in addition offer a Combination Dash and Inspection Lamp popular and practical on every style of car.

To serve owners whose cars are not PRESTO equipped, most good dealers handle the PRESTO line.

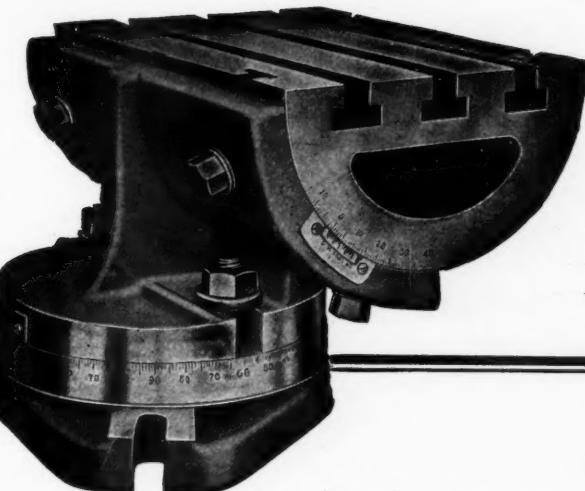
Manufacturers, write direct. Dealers, order from your jobber.

METAL SPECIALTIES MFG. CO., INC.
332 to 338 N. Kedzie Ave., Chicago
Eastern Branch: 16-24 W. 61st St., New York
Western Branch: 149 New Montgomery St., San Francisco



Combination Dash
and Trouble Lamp

Please mention The Automobile when writing to Advertisers



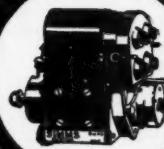
Universal Angle Plate

Replace your inaccurate and makeshift rigs with the UNIVERSAL ANGLE PLATE. This beautiful and efficient tool is particularly adapted to Jig and fixture work, and will be found indispensable in the tool room. Has a motion through 360° horizontally, and 90° vertically. Can be adjusted quickly to any angle without disturbing work bolted on plate. Accurate graduations with vernier attachment permit of especially careful work. Rigid and Well Built.

Dimensions and Prices	
4 x 6.....	\$ 50.00
6 x 8.....	75.00
8 x 10.....	100.00

Has unlimited possibilities of application for exceptional work on Lathes, Planers, Milling Machines, Shapers, Drill Presses and Grinders.

Boston Scale and Machine Company
381-389 Congress Street Boston, Mass., U. S. A.



An Inefficient Engine

is a continual strain on the operator. No matter what adjustments are made, if the ignition system is inherently lacking, the motor is handicapped.

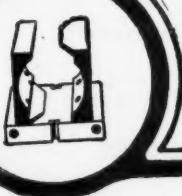
HIGH TENSION SIMMS MAGNETOS

with their ability to produce the same intensely hot spark in the full retard or advance will increase the power, flexibility and efficiency of any engine.

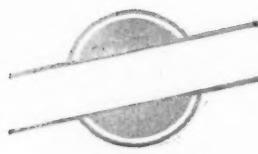
Write for literature

THE SIMMS MAGNETO CO.

273 No. Arlington Ave.
East Orange, N. J.



Please mention The Automobile when writing to Advertisers



For advance information
wire or write Motor Age,
95 West Fort St., Detroit

**The Only Truck Attachment that
Includes Unit, Cab and Body in
one Job at one Price**



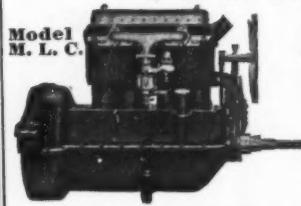
Saves you \$75 to \$125 on body
equipment. Write for booklet.
Get our dealers' proposition.

GRAHAM BROTHERS, Dept. E, Evansville, Ind.



Passenger
and
Commercial
Car
Motors

Model
M. L. C.



4-Cylinder-4-Cycle

Beaver Motors Fit Every Demand

There are BEAVER Motors in a variety of sizes, suitable for all pleasure car and commercial car requirements. Meet all demands for power, economy and dependability.

Over-head valves. 20% to 25% more power than other motors of same bore and stroke.

Write today for BEAVER specifications before deciding on the motor to use.

BEAVER MFG. CO.

1st & Oklahoma Ave., Milwaukee, Wis.

OLD SOL
NITROJECTOR NO 100
THE 100% PERFECT SPOTLIGHT

\$10

Complies with all laws for no-glare devices. Other dependable Old Sol Spotlights are No. 70—\$7.00, No. 77—\$5.00. Ask for Old Sol for Safety.

Hawthorne Mfg. Co., Inc., Bridgeport, Conn.

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* Complete Line of *

GREASE CUPS, OIL CUPS AND OIL HOLE COVERS



SPRING SHACKLE
BOLTS



HUB CAPS

METAL STAMPINGS
IN LARGE QUANTITIES

Plain Manufactured by
THE WINKLEY CO., Detroit,
Canadian Factory: CANADIAN WINKLEY CO., LTD., Windsor, Ont.

Sectional
Mich.

Quick Deliveries

on

Demountable Tops for
FRANKLIN, CADILLAC and COLE
Write or wire for details.

**THE
MULHOLLAND
CO.**

Body Builders for over 50 years.
DUNKIRK, N. Y.



INDIANA TIRE

Inner Tubes, Inner Liners, Outer
Boots, Inner Sleeves, Blowout
Patches, Cementless Patches, Ce-
ment Patches, Red Rubber Tubing.

MASTER

Calorite Spark Plugs
The highest achievement in spark plug construction—
MASTER CALORITE SPARK PLUGS

are backed by this broad guarantee—
"We guarantee Master Calorite Spark Plugs against
defects of material or workmanship and will replace
free of charge any Calorite insulators broken by heat
which are returned to us transportation prepaid."
All standard threads carried in stock.
Try Master Calorite Spark Plugs—Send for
illustrated literature and trade proposition
HARTFORD MACHINE SCREW CO.
482 Capitol Ave., Hartford, Conn.

Hartford
UNIVERSAL Joints



Established 1906

The
Hartford Automobile Parts Co.
Hartford, Conn.

We are able to offer manufacturers universal joints manufactured by specialists in one of the largest plants in the world.

The wearing surfaces of HARTFORD UNIVERSAL JOINTS are hardened and ground, the grinding being accomplished by a specially devised machine whose use eliminates depressions or elevations so common in steel parts that have been simply reamed.

The reputation of your car demands the best universal joints that can be made, and we have them.



For advance information wire or write MOTOR AGE, 195 West Fort St., Detroit.

A splendid opportunity for big distributors in the East. See announcement next week.



FUL FLO

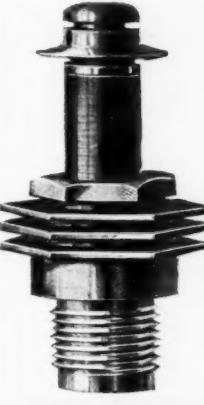
The most efficient water pump for cooling your engine, —automobile, aeroplane or marine.

Attractive prices on quantities.

Let us tell you about it.

The Fulflo Pump Co.
128 Opera Place CINCINNATI, OHIO

BERKSHIRE AVIATION TYPE SPARK PLUG



Made of finest quality brass and mica. Exceptionally rugged. Gas-tight, cold proof, water proof, will not break or work loose. Specially designed for aviation use, this plug is as near perfection in design and construction as we can make it.

Pittsfield Spark Coils are widely known for their absolute reliability.

Pittsfield Timers have an established reputation for complete accuracy.

The **Pittsfield Distributor** is unique in its positive mechanical make and break.

Pittsfield Spark Coil Co.
Pittsfield Mass.



The Bearings Company of America
LANCASTER, PA.

Western Office: 604 Ford Building, Detroit, Mich.



COMPLETE THRUST BEARING

RADIAL RETAINERS

MADE IN AMERICA

Manufacturers of Radial Star Ball Retainers, Star Ball Thrust Retainers, Complete Star Ball Thrust Bearings



Dyneto
Electric Starting and Lighting Systems
SINGLE UNIT and TWO UNIT Equipments
Booklet on Special Ford Equipment
DYNETO ELECTRIC CO., Syracuse, N. Y.

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Save Money, Pain, and Perhaps Disaster!

Carry a Martinkit in your car and be prepared to treat cuts, bruises, burns and even bad wounds accidentally received. It costs but \$2.00.

Jobbers and Dealers, Write Us for Our Proposition.

MARTINKIT
FIRSTAID TRADE MARK
Martin Auto Accessories Corporation Rochester, N. Y.



SPRINGS YOU ARE SURE OF



No uncertainty as to service or wear of
HIGGINS QUALITY SPRINGS
For Replacement

No center breakage—new nib construction prevents it. Absolute security from tip to tip—combined with utmost riding comfort. Squeak and rust-proof. Painted black. Ready for installation. For all cars. Quick service. Big discounts to dealers. Write for catalog C 1917 and Prices.

HIGGINS SPRING & AXLE CO.
Dept. 13 Racine, Wis.

NO BOLT-NO HOLE-NO HUMP



For advance information wire or write
MOTOR AGE, 95 West
Fort St., Detroit.

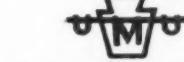
On the *price*
of the cars you
handle depends
the *amount* of
business you do.
See announce-
ment next week.

DETROITER SIX-45
The Six of Advanced Construction
UNIQUE VALUE \$1250 RAPID SELLER
Detroiter Motor Car Co., Detroit, Mich.

SHEET METAL STAMPING

THE CROSBY COMPANY
BUFFALO, N. Y.

KEYSTONE MOTOR



6 Cylinders
2 1/2" Bore x 4 1/2" Stroke
375 BHP at 2650 RPM
25 Miles per
Gallon Gas on
2600 1b. Car ~

KEYSTONE MOTOR MFG. CO.
EAST GREENVILLE . . . PENNA.

NEW PROCESS
ACCURATELY CUT
METAL GEARS
and BAILEY Non-Skid
Non-Stall Differentials



NEW PROCESS
GEAR CORPORATION
SYRACUSE, N. Y.

National Speedway Tires

For quality, stamina, strength and general dependability, just test a NATIONAL "Speedway" against the tires you are now using.

National Rubber Co., Pottstown, Pa.



THE FULTON TRUCK

1 1/2 Ton Capacity

Has created the world's standard in motor truck value

If you are interested in a real money making agency where selling resistance has been reduced to a minimum, communicate with us NOW.

Fulton Motor Truck Co., Farmingdale, L. I., N. Y.



NUMBER 419



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Loring French
W. H. Rogers

Franklin P. Whittemore

Electric Auto-Lite

Starting—Lighting—Ignition

Electric Auto-Lite equipment for automobiles is as famous for the service that backs it as for the reliability and economy of its operation.

ELECTRIC AUTO-LITE COMPANY

Home Office and Factory: Toledo, Ohio

New York Detroit Kansas City San Francisco

For advance information wire or write
MOTOR AGE, 95
West Fort St.,
Detroit.



If you believe all you need is the *chance* to become a big-caliber dealer or distributor, see announcement next week



OWEN MAGNETIC

WHAT IS YOUR UNDERSTANDING
OF FLEXIBILITY?

Flexibility means (according to the advertisements) the ability of a car to slip from low speed into high, or from high into low, with extreme smoothness and celerity.

Flexibility—approached in other cars—is actually attained in the Owen-Magnetic.

**BAKER R & L
COMPANY**
Cleveland, Ohio
Manufacturers of
OWEN MAGNETIC
MOTOR CARS

Salesrooms— New York Boston Philadelphia Chicago



E. & J. SPOTLIGHT

Motorists insist on having the best spotlight manufactured. DEALER: Satisfy your customers by selling them the best and latest improved Spotlight manufactured. Complete in every respect. Ready to attach.

Edmunds & Jones Corporation
Detroit, Michigan



BOSCH

The ignition that is used by the world's fastest cars because it is the most reliable and efficient. Be Satisfied Specify Bosch

Bosch Magneto Co.
220 West 46th St., New York



IRIDIO-PLATINUM TIPPED Screws and Rivets

SERVICEABILITY

is a distinguishing feature of these Screws and Rivets.

Securely welded Iridio - Platinum heads. Standard sizes carried in stock. Other styles to order—any specifications, any degree of hardness.

Write us for prices and full information.

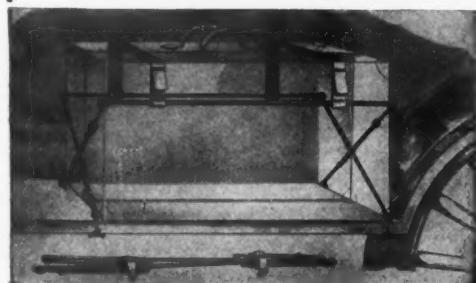
R & H Platinum Works

of Roessler & Hasslacher Chemical Co.

New York

The "Grip-Tight" Suit Case Holder and Luggage Carrier

Convenient—Inexpensive—Holds Fast—No Rattling or Swaying



Holds absolutely tight. Removed and carried under seat when not in use. Weighs 3 lbs. Carries 300 lbs. If dealer hasn't it will send parcel post on receipt of price. \$4.00 (complete with canvas bag).

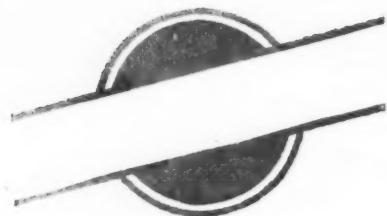
The Grip-Tight Holder Co.
Norwich New York



ZENITH CARBURETOR

KNOWN the world over as the *zenith* of carburetor efficiency. A long list of American builders of cars, trucks and aeroplanes believe this simple, plain tube device to be the best insurance for permanent carburetor satisfaction.

Zenith Carburetor Co.
New York Detroit, U.S.A. Chicago



"Confidential" will be answered direct by
MOTOR AGE and so treated.

For advance
information
wire or write
MOTOR AGE,
95 West Fort
St., Detroit,
Mich. Inqui-
ries marked

THE METAL OF METTLE



THE BEST BEARING METAL ON THE MARKET

Fahrig Metal is an exceptionally homogeneous tin base copper hardened alloy made by our special process from Straits tin and ingot copper. We make every pound of Fahrig Metal ourselves and can guarantee its uniformity and quality. Ask Stutz, Simplex, Crane, Wisconsin, Kissell, Waukesha, Kelly-Springfield, Beaver, Curtiss and the man who makes finished bearings.

Fahrig Metal Company, 34 Commerce Street, New York

Standard Equipment on Packard, Marmon, National, Haynes, Kissel, Pathfinder, Etc.

BURD HIGH COMPRESSION RING CO.
Rockford, Illinois

Sales Offices in all Principal Cities

HYATT QUIET

-the logical bearing

for Motor Cars
Motor Trucks and
all Motor Vehicles

Please mention The Automobile when writing to Advertisers

HECO

VACUUM FUEL SYSTEM

Only One Valve

Positive Mechanical Action
No Loss From Evaporation
Simple Sturdy Construction

HEINZE ELECTRIC CO.
Lowell, Mass.
Detroit
Chicago

JUMBO
SPARK
PLUGS

Jumbo
"MOLITE"
50 Cents
Guaranteed For The
Life of The Car

Other types for
Fords and other
cars, 45 cents.
Ask your dealer
or write direct to
the manufacturers.

69-37

GIBSON-HOLLISTER MFG. CO.
3380 WASHINGTON ST.,
JAMAICA PLAIN, MASS.

Are You Sure of Your Lights?

Or are you running the risk that lights, spark, starter may fail you suddenly—perhaps on a dangerous road, on a black night? Don't guess! Make sure of your electrical equipment by putting a



Weston
MODEL 354 AMMETER

On Your Dashboard or Cowl
It is the reliable means of determining
the proper rate of charge or discharge of
your battery for various speeds. It en-
ables you to determine that the generator
is working and that the storage battery
is receiving its proper charge. Write us.

Weston Electrical Instrument Co.
8 Weston Ave., Newark, N. J.
23 Branch Offices in the Larger Cities

It Smothers the Bump

Hartford BUMP ABSORBER
—more than a Bumper

THE NATIONAL GUARD FOR MOTOR CARS

EDWARD V. HARTFORD, Inc., 144 Morgan Street, JERSEY CITY, N. J.

It Will Not Leak

Unlike common greases, NON-FLUID OIL does not melt, cannot leak out of the differential, destroy brake band lining, rot tires.



always retains its even consistency regardless of weather or driving conditions.

NON-FLUID OIL is a highly perfected friction-killing, long-lasting lubricant that is far superior to any greases. ASK FOR IT BY NAME.

"K-OO Special" grade is for gears, "K-OOO" for bearings.
Write for samples and literature.

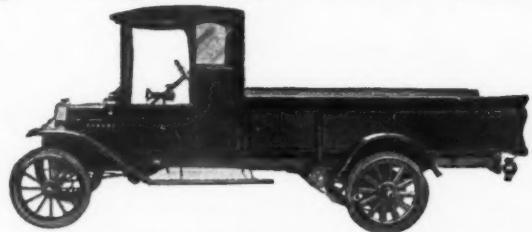
New York & New Jersey Lubricant Co., 165 Broadway, N. Y. City

For advance information
wire or write MOTOR
AGE, 95 West Fort St.,
Detroit.



Dealers in the
South and South-
East see announce-
ment next week.

Open Express and Panel Bodies



for All Truck Attachments for Fords
Lowest Prices

LONDON AUTO SUPPLY CO.
2548 Wabash Avenue CHICAGO

"Removes sulphation
from battery plates."

WARD LEONARD
26 YEARS
EXPERIENCE
DYNAMO
CONTROLLERS
FOR
LIGHTING
AND
STARTING
SYSTEMS

THE AUTOMOBILE ENGINEER

PUBLISHED MONTHLY
The only technical journal in the world *solely* devoted to the theory and practice of Automobile Construction.

Among the subjects dealt with are Chassis Design; Engine Design; Parts and Accessories manufacture; Metals; Machine tools; Fuels; Shop practice; Works organization and equipment.

Each issue contains invaluable information for manufacturers, designers and departmental managers.

Subscription Rates:
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The Publishers:
ILIFFE & SONS, Ltd., 20 Tudor Street, London, E. C.

Celfor

Internal Gear Drive Axle

The name guarantees the product—the product is a credit to the name.

Send for handsomely illustrated booklet "Twelve Talks to Engineers"

CLARK EQUIPMENT CO.
Buchanan,
Mich.

"I didn't know such riding comfort and such driving ease were possible," said a Liberty buyer. The

LIBERTY

is built to satisfy you, with a score of exclusive features for your satisfaction. Let them prove themselves to you—today. \$1195.

Liberty Motor Car Co.
Detroit

The Clearing House

of the Automobile Industry

For Second Hand Cars, Surplus Parts, Accessories, Tires
Machinery & all other Special Announcements of a Similar Character

GEARS TRANSMISSION (TO FIT)

HERRESHOFF—Model 20

Main Sliding Shaft	\$8.00
Second and High Sliding Gear (Selective)	8.00
Low and Reverse Sliding Gear (Selective)	8.00
Main Drive Gear	11.00
Countershaft with gear integral	10.00
Countershaft Low Speed Gear	6.00
Countershaft Second Speed Gear	8.00
Countershaft Drive Gear	7.00
Reverse Idler Gear (Bushed)	5.00

INTERSTATE

Sliding Shaft	\$9.00
Low and Reverse Sliding Gear	10.00
Second and High Sliding Gear	11.00
Countershaft	5.00
Countershaft Drive Gear	7.00
Countershaft Second Speed Gear	7.00
Countershaft Low Speed Gear	6.00
Countershaft Reverse Gear	5.50
Reverse Idler Gear	7.00

MARION—Model 36-37

Main Sliding Shaft	\$8.90
Main Drive Gear	11.70
Second and High Sliding Gear	8.90
Low and Reverse Sliding Gear	8.90
Countershaft	3.90
Countershaft Second Speed Gear	6.25
Countershaft Low and Reverse Gear (Integral)	8.80
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The materials listed above are in stock for immediate delivery, and are made from 3½% nickel steel, being the exact reproduction of the manufacturer who installed the original units in the car when manufactured.

We do not carry any second-hand or junk material—at the prices quoted above, it does not pay to rely on damaging your entire transmission by putting in second-hand or cheap-rate material.

Bulletin No. 20

J. C. Gorey & Co.

354 West 50th Street, New York

Auto Needs

of every description

Write us and save money

Bosch Magneto, D U 4.	\$20.00
Prest-O-Lite Tanks	6.00
Rexo Motor Horns (new)	2.35
Clero Hand Horns (new)	2.15
6 in. Electric Headlights, pair (new)	2.25
8 in. Electric Headlights pair (new)	2.75

A wonderful stock of new guaranteed fresh stock tires and tubes sacrificed.

ORDER NOW

Brand New Tires and Tubes at a saving of over 65%.

	New		Used	
	Tires	Tubes	Tires	Tubes
30 by 3	\$7.75	\$1.50	\$4.00	\$1.10
30 by 3½	9.75	2.25	4.75	1.25
31 by 3½	10.25	2.50	4.00	1.50
32 by 3½	10.50	2.50	5.75	1.40
34 by 3½	12.50	2.45	6.00	1.50
31 by 4	13.65	2.65	6.75	1.55
32 by 4	14.35	2.80	7.00	1.55
33 by 4	14.50	3.00	7.75	1.60
34 by 4	14.90	3.15	8.25	1.65
35 by 4	15.25	3.35	8.00	1.70
36 by 4	15.50	3.45	8.00	1.75
33 by 4½	15.00	3.00	7.50	2.00
34 by 4½	17.85	3.85	8.25	1.75
35 by 4½	19.65	3.90	8.90	1.80
36 by 4½	19.85	4.00	9.50	1.85
37 by 4½	21.70	4.15	9.75	1.90
35 by 5	19.50	4.25	10.00	1.90
36 by 5	20.80	4.35	9.00	2.00
37 by 5	22.00	4.50	10.50	2.10

10% more for non-skid.

SERVICE AND SATISFACTION GUARANTEED

One dollar deposit or sufficient to defray express charges required with each order.

SHIPMENTS MADE PROMPTLY, SUBJECT TO YOUR INSPECTION.

AutoNeeds Company

1602 So. Michigan Ave.,
CHICAGO, ILL.

Goodyear Motz Cushion Solid Tire
Service Station

Please mention The Automobile when writing to Advertisers

You Can't Beat Our Prices

PARTS For All Cars

can be obtained from us and
We Save You From

50% to 80%
Money Cheerfully Refunded

If we satisfy you tell others, if not, tell us.

LOOK!!!

at the following Bargains:

MOTORS	
4 cyl. Continental block motor	\$100.00
4 cyl. Wisconsin motor	100.00
6 cyl. Wisconsin motor	125.00
R. C. H. motor	45.00
1912 Cole Unit Power Plant	75.00
1914 Cole 6 cyl. Unit Power Plant	125.00
Hudson 33	65.00
E. M. F. motors	65.00
Flanders	60.00
1912 Buda motors	100.00
4 cyl. Excelsior motor	85.00

OVER 500 MOTORS IN STOCK
So Let Us Know Your Needs

BOSCH MAGNETOS

DU 4 Set Spark	\$16.00
DR 4 & 6	17.50
D 4 & 6 Single or Dual	16.00
DR 4 & DU 4 Variable Spark	20.00
Elsemann H. T. Mags	10.00
Remy Mod. RL and D	7.00
New 6 cyl. Remy Distributors	5.50
Dixie Mags	12.00

COILS

Bosch Type A	\$5.48
Elsemann	4.00
Splitdorf	3.50
B-Presto Tanks	5.00

We Carry in Stock
ALL MAGNETO PARTS

REAR AXLES

Any style or make

\$15 to \$35

SPEEDOMETER HEADS

Stewart or Warner

\$1.50 to \$4.00

We wreck from 10 to 15 cars every day and thus obtain

Hundreds of Slightly Used RIMS

Continental	\$2.50
All other makes	1.50

Tires and Tubes

Which Are Good for Thousands of Miles
of Service.

Are You Lucky enough to use the following sizes?

32 x 4	\$5.00
34 x 3½	5.00
34 x 4	6.00
35 x 4	6.00

Prices on other Sizes will Interest You

MAIL ORDERS SHIPPED SAME DAY

Highest Price Paid for Wrecked Cars

WARSHAWSKY & CO.

Largest Car Wreckers in Chicago

1925 S. State Street, Chicago, Ill.
TWO PHONES—CAL. 1388; CAL. 6794

Car Owners Dealers Garage Men

All kinds of parts for the following cars on hand ready to ship at a moment's notice

At 50% to 75% Off Regular List Price

Buick
Bergdoll
Brush
Cadillac
Carter Car
Chalmers
Corbin
Cutting

Everett
E. M. F.
Elmore
Flanders
Franklin
Hudson
Haynes
Inter-State

Jackson
Knox
KisselKar
Krit
Locomobile
Lozier
Maxwell
Mitchell

Mathewson
Moline
Oakland
Oldsmobile
Overland
Palmer Singer
Peerless
Pierce Arrow

Pope Hartford
Packard
Pope Toledo
Rambler
Reo
R. C. H.
Regal

Stevens-Duryea
Speedwell
Stoddard-Dayton
Studebaker
Thomas
Velie
Winton
Selden

These parts are guaranteed and consist of axles, transmission gears, pistons, springs, cylinders, crank shafts, cam shafts, lamps, axle-housings, wheels, rims, etc.

LOOK AT THESE BARGAINS!

Prest-O-Lite Tanks, Style E, \$4.50; Style B, \$5.00
Bosch Magneto, D4, \$14.50; DU4, \$22.50; DR4, \$20.00;
DU6, \$25.00; DR6, \$22.00; ZR4, \$25.00

Carburetors, \$5.00
Bosch Coils, \$10.00
Splitdorf Coils, \$10.00

Remey Magneto, \$4.50
Splitdorf Magneto, \$7.50
Timken Bearings, \$1.25

POPE-HARTFORD PARTS

We have more Pope-Hartford parts than any other parts dealer and will sell them at an extra low figure. Get our prices on these parts.

Satisfaction guaranteed or money refunded.

Connecticut Auto Parts Co., 1070 Main St., Hartford, Conn.

PARTS AND REPAIRS

To All Owners of Maxwell-Briscoe

Maxwell 6-50
Maxwell 4-35
Flanders "Six"

Stoddard-Dayton Everitt

Brush
Courier-Car
Columbia

Courier Clermont Sampson "35" Motor Cars Alden-Sampson Trucks

The Maxwell Company has transferred to the Standard Motor Parts Company the entire Service Department on all of the models above listed, and all orders for repair parts should be placed direct with the Standard Motor Parts Company, New Castle, Indiana. Better Service will be given these owners than ever before, and many reductions in repair parts prices have been effected.

ADDRESS ALL ORDERS AND
INQUIRIES DIRECT TO THE

Standard Motor Parts Company
New Castle Indiana

KRIT OWNERS

We furnish quick service on all engine, clutch transmission, differential front and rear axle steering gear, wheels, steering knuckles and cones, fenders, frames and body parts from original Krit Stock. For all models from 1909-1915 inclusive.

MOTOR CORPORATION
1300 Race St. Philadelphia, Pa.

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GUARANTEED 4000 MILES

If our tires fail to run 4000 miles we
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Non- Size	Plain	Skid	Size	Plain	Skid
30x3	\$6.50	\$7.50	34x4	\$12.95	\$13.95
30x3 1/2	7.95	8.95	35x4	13.45	14.95
32x3 1/2	8.95	9.90	36x4	13.95	15.50
34x3 1/2	9.60	10.45	34x4 1/2	16.95	18.95
36x3 1/2	10.45	11.85	35x4 1/2	17.45	19.45
30x4	11.20	12.10	36x4 1/2	17.95	19.95
31x4	11.45	12.60	37x4 1/2	18.45	20.45
32x4	11.95	12.95	35x5	19.45	21.95
33x4	12.45	13.50	37x5	20.45	23.25

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4000 MILES

GUARANTEED ON
Hercules Tires

Read Our Liberal Guarantee as Follows:

If a tire fails to run 4,000 miles we will
replace it with another tire for one-half
regular price.

Plain	Non Skid	Tubes
28x3	\$6.80	\$7.20
30x3	7.20	7.60
30x3 1/2	9.30	9.75
32x3 1/2	10.70	11.20
34x3 1/2	11.95	12.55
31x4	14.35	15.10
32x4	14.60	15.35
33x4	15.25	16.00
34x4	15.55	16.25
35x4	16.35	16.95
30x4	16.35	17.25
34x4 1/2	20.80	21.85
35x4 1/2	21.60	22.70
36x4 1/2	21.90	22.95
37x4 1/2	22.70	23.80
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Will run 5,000 miles and more

30x3 \$5.00 32x3 1/2 \$6.50 34x4 \$8.25

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All sizes; send \$1 deposit, bal. C. O. D. Reliner

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OUR GUARANTEE

If a Tire Fails to Run

5000 MILES

we will replace it with another tire
for one-half the price marked below:

Size	Non-Skid	Tubes	Size	Non-Skid	Tubes
28x3	\$7.95	\$2.25	35x4	\$19.50	\$4.05
30x3	8.90	2.34	36x4	20.30	4.15
30x3 1/2	10.50	2.68	34x4 1/2	22.00	4.95
31x3 1/2	11.50	2.70	35x4 1/2	23.50	5.05
32x3 1/2	12.95	2.79	36x4 1/2	24.10	5.15
34x3 1/2	14.80	2.92	37x4 1/2	25.50	5.25
31x4	16.80	3.65	35x5	27.50	6.05
32x4	17.95	3.78	36x5	28.80	6.10
33x4	18.40	3.87	37x5	29.50	6.25
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30 x 3 1/2	4.00	36 x 4	6.50
32 x 3 1/2	4.50	34 x 4 1/2	7.00
34 x 3 1/2	5.00	35 x 4 1/2	7.00
31 x 4	5.00	36 x 4 1/2	6.50
32 x 4	5.00	37 x 4 1/2	7.00
33 x 4	6.00	35 x 5	7.00
34 x 4	5.50	36 x 5	8.00

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30x3 1/2	6.50	7.00	33x4 1/2	11.00
31x3 1/2	7.00	7.50	34x4 1/2	12.00
32x3 1/2	7.50	8.00	35x4 1/2	12.00
34x3 1/2	8.50	9.50	36x4 1/2	13.00
32x4	9.00	10.00	37x4 1/2	13.00
33x4	9.00	10.00	34x5	14.00
34x4	9.50	10.50	35x5	14.00
35x4	10.00	11.00	36x5	15.00
36x4	10.00	11.00	37x5	15.00
36x4	10.00	11.00	37x5	16.00

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33x4	3.20	37x5	6.00

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New 30 x 3 1-2 Non-Skid (Unguaranteed)

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Special Ford regrinding \$10 per set.

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NO REGARD FOR DISTANCE. If you are east of Rocky Mountains we allow freight on barrel of genuine Packard Auto Oil at 29c. No charge for barrel, which sold will reduce your oil to about 27c. Send us your order for a barrel and save money; less quantity, 39c a gallon. Albert E. Hale Co., 3 P. O. Sq., Springfield, Mass.

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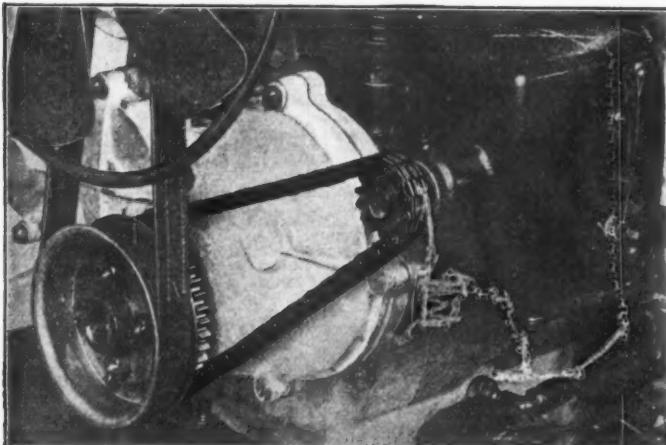
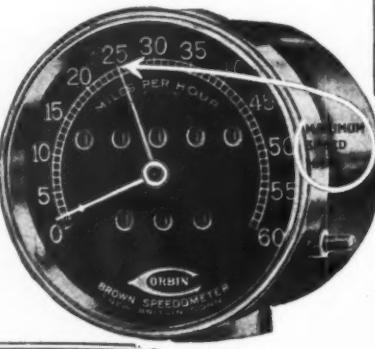
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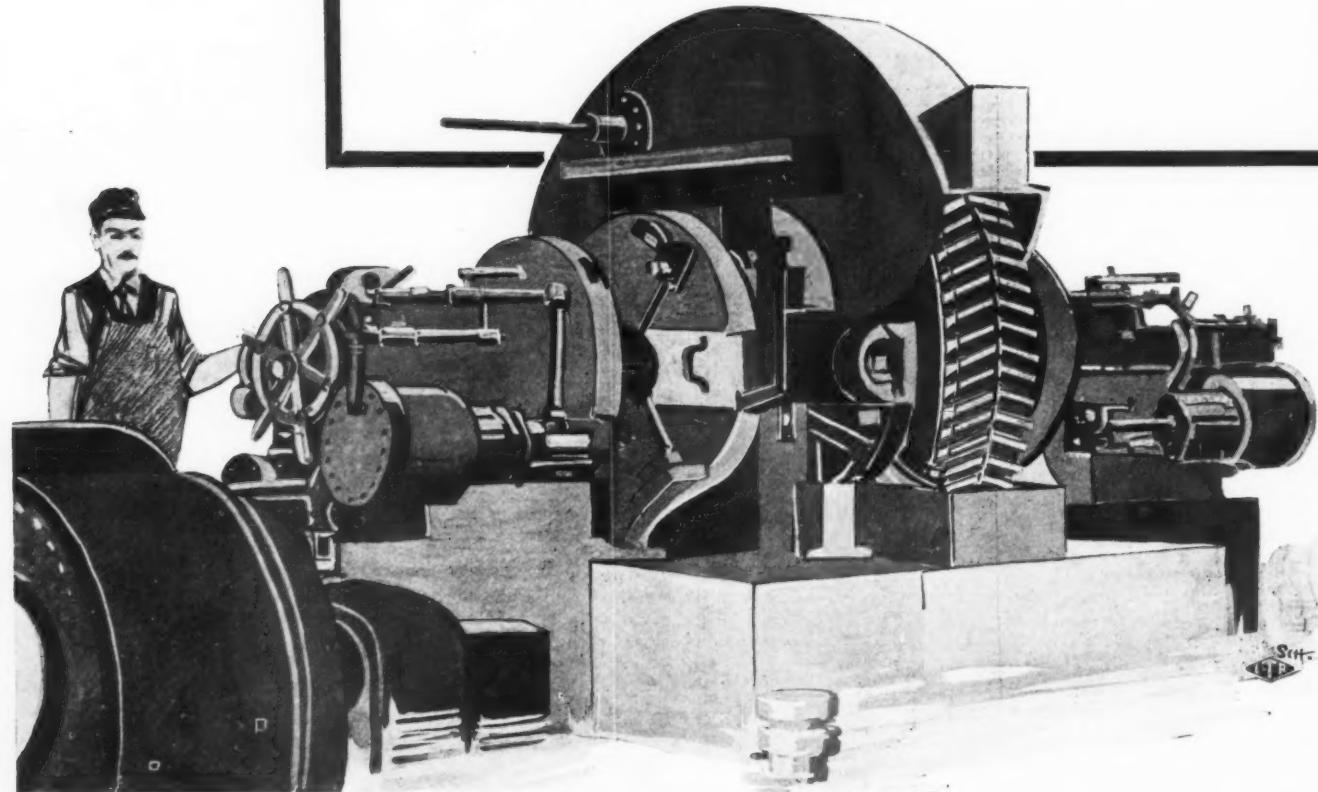
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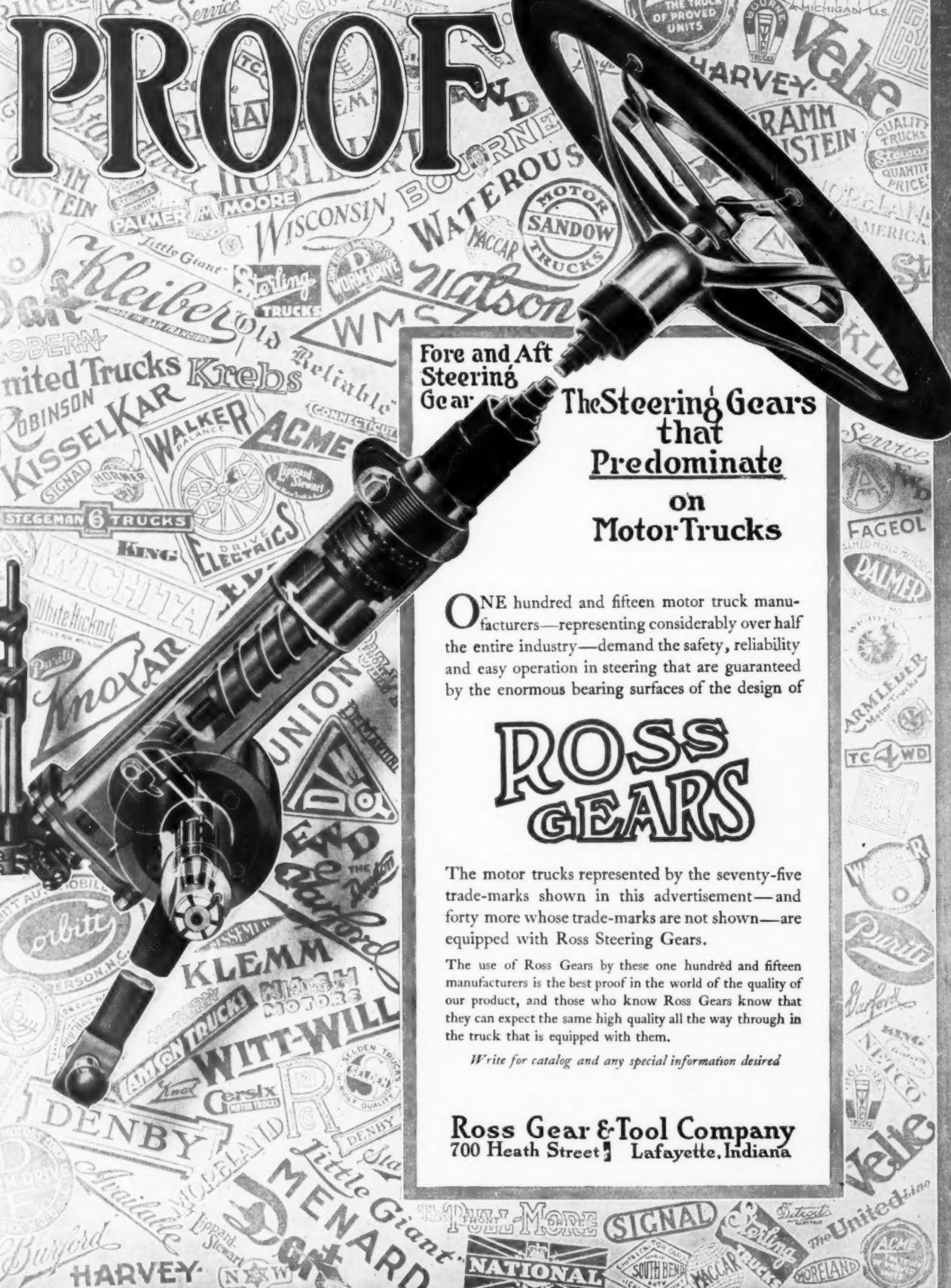
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